The Engineer.

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The Engineer

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PUBLIC NOTICES.

TO CONTRACTORS.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Thursday, 23rd July, 1931, for the SUPPLY of (a) MECHANICAL and (b) ELECTRICAL ENGINEERING LABOUR in the Manchester District during a period of three years from the 1st August, 1931.

Forms of Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1. 7189

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 14th July, 1931, for INSTALLATION of a LOW-PRESSURE HOT WATER HEATING APPARATUS at Dudley House, Endall-street, W.C. 2.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7208

HEATING.

The Commissioners of His Majesty's Works, &c., are prepared to receive TENDERS before 11 a.m. on Tuesday, 21st July, 1931, for ACCELERATED LOW-PRESSURE HOT WATER HEATING and HOT WATER SERVICE SYSTEM at Kensington Telephone Exchange, S.W. 3.

Drawings, specification, a copy of the conditions and form of contract, bills of quantities and forms for Tender may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1, on payment of One Guinea. (Cheques payable to the Commissioners, H.M. Office of Works.) The sums so paid will be returned to those persons who send in Tenders in conformity with the conditions. 7207

Ministry of Transport.
ROADS DEPARTMENT.

APPLICATIONS are INVITED for a POST as UNESTABLISHED ASSISTANT for work in connection with Road Traffic, in the Headquarters Offices of the Ministry. Candidates should have completed a recognised course of training in Civil Engineering, both theoretical and practical. Salary, £250 to £350 inclusive. Preference will be given to men who have served in His Majesty's Forces.

Forms of application can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1. Last day for receipt of application forms, 14th July, 1931.

1st July, 1931. 7209

Armstrong College,

NEWCASTLE-UPON-TYNE.
(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.Sc. and the HONOURS DEGREE of B.Sc. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
6289 Newcastle-upon-Tyne.

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, LONDON, E.C. 1.
FULL-TIME COURSES IN
ENGINEERING
are provided as follows:—
MECHANICAL,
CIVIL,
AERONAUTICAL,
ELECTRICAL, and
ELECTRICAL COMMUNICATION.

The Polytechnic is an Institution of the University of London, and courses are arranged to prepare matriculated students for the B.Sc. (Engineering) Degree of the University.

Entrance Examination, Wednesday and Thursday, 15th and 16th July, 1931.

For prospectus apply to
7132 THE PRINCIPAL.

Harris Institute, Preston.

The Council of the Harris Institute, Preston, invite APPLICATIONS for the POST of PRINCIPAL.

Candidates must be Graduates of a British University or hold equivalent qualifications, and must have had suitable technical experience.

The commencing salary will be £800, rising by annual increments of £50 to a maximum of £1000.

The Harris Institute is a recognised College for Further Education; it has Day and Evening Courses organised in Departments of Engineering, Science, Textiles, Commerce, Art, and Building Trades. There is also a Junior Technical and Junior Commercial School accommodated in the College, for which the Principal is responsible.

Forms of application, together with list of duties and further particulars, may be obtained from the President—

Alderman H. ASTLEY BELL, Esq., J.P.,
The Harris Institute,
Corporation-street, Preston,

on receipt of a stamped addressed envelope, and should be returned not later than 31st July, 1931.

Canvassing, either directly or indirectly, will be deemed a disqualification. 7187

University of Liverpool.

FACULTY OF ENGINEERING.

DEAN; Professor G. E. SCHOLES, M.B.E., M.Sc., M.I.A.E., M.I. Mech. E.

PROSPECTUS and Full Particulars may be obtained on application to the REGISTRAR of COURSES designed for Students desiring to qualify as Mechanical, Electrical, Civil, or Marine Engineers, as Naval Architects, or as Metallurgists and Metallurgical Engineers. 6832

Bengal Nagpur Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for—

275 STEEL CARRIAGE and WAGON AXLES.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Tuesday, 30th June, 1931.

A fee of 10s. will be charged for each copy of the specification, which is NOT returnable.

Tenders must be submitted not later than NOON on Friday, 10th July, 1931.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. GRANT,
7183 Secretary.

Waltham Holy Cross Urban DISTRICT COUNCIL.

The above Council is prepared to receive TENDERS for SUPPLYING and ERECTING at the proposed New Pumping Station at Honey-lane, TWO 3in. VERTICAL-SPINDLE ELECTRICALLY DRIVEN CENTRIFUGAL SEWAGE PUMPS, with Automatic Control Gear complete.

Further particulars will be sent by the undersigned on receipt of a stamped 2d. addressed brief envelope.

Tenders, sealed and endorsed "Tender for Sewage Pumps," must be in the hands of F. C. E. Jessopp, Esq., Clerk to the Council, Waltham Abbey, by Five o'clock p.m. on Monday, the 20th July, 1931.

The Council does not bind itself to accept the lowest or any Tender.

W. C. HOLLOWAY,
Engineer and Surveyor.
Town Hall, Waltham Abbey,
June, 1931. 7184

Bracebridge Mental Hospital, LINCOLN.
HEATING INSTALLATION, &c.
VACUUM RETURN SYSTEM.

The Committee of Visitors to the Bracebridge Mental Hospital, Lincoln, are desirous of obtaining TENDERS for a CENTRAL HEATING SYSTEM, HOT WATER SERVICES and certain Pumping Installations for the New Admission Hospital, now under construction at Bracebridge Heath, near Lincoln.

A list of suitable firms wishing to tender for this work will be prepared, from which not less than six will be selected and to whom the plans and specification will be submitted by the Consulting Engineer to the Committee, Mr. E. G. Phillips, M.I.E.E., A.M.I. Mech. E., for the purpose of receiving Tenders, which will be duly considered by the Committee concerned.

Application for inclusion in the list from which selection will be made should be addressed in the first place to—

HAROLD E. PAGE, Esq.,
Clerk to the Visiting Committee of the Bracebridge Mental Hospital.
5 and 6, Bank-street,
Lincoln. 7188

City of Bath.
PUBLIC ASSISTANCE COMMITTEE.
FROME-ROAD HOUSE, BATH.
TO HEATING ENGINEERS.

TENDERS are INVITED for the INSTALLATION of a NEW BOILER and EXTENSION of the HEATING SERVICES to the Mental Block, in accordance with plans and specification prepared by the Consulting Engineer, Mr. Edwin S. Hoare, B.Sc., A.M.I.C.E., Bristol.

Sealed and endorsed Tenders must reach the undersigned not later than 10 a.m. on Tuesday, the 21st July, 1931.

Copies of the specification and plans may be obtained on application to the undersigned on payment of a deposit of £2 2s., which will be returned on submission of a bona fide Tender.

The Committee do not bind themselves to accept the lowest or any Tender.

C. J. BUTLIN,
Director of Public Assistance.
Public Assistance Offices,
12, Charlotte-street, Bath,
30th June, 1931. 7185

PUBLIC NOTICES.

Midlothian County Council.
RECONSTRUCTION OF TORPHIN BRIDGE, NEAR WEST CALDER.
CONTRACT FOR WORKS.

The County Council of Midlothian is prepared to receive TENDERS for TAKING DOWN TORPHIN BRIDGE over the Bog Burn, near Harburn, and for the CONSTRUCTION of a NEW BRIDGE there in Steel and Concrete, and for ALTERATIONS to the ROAD APPROACHES.

Under the contract 20 per cent. of the labour employed must be drawn from distressed areas, and engaged through the local employment exchange.

The drawings, specification and schedule of quantities may be seen at the office of Messrs. Blyth and Blyth, MM. Inst. C.E., Civil Engineers, 135, George-street, Edinburgh, on and after WEDNESDAY, 1st JULY, 1931. Copies of the specification and duplicate copies of the schedule of quantities and form of Tender may be obtained from them on depositing £5 5s. Cheques, made payable to the County Council, will be returned on receipt of a bona fide Tender.

An engineer will meet the contractors at Torphin Bridge at 11.30 a.m. on TUESDAY, JULY 7th, to show them the site of the works.

Sealed Tenders, marked on the outside "Tender for Torphin Bridge," must be lodged with the undersigned not later than first post on MONDAY, JULY 20th, 1931.

The Council do not bind themselves to accept the lowest or any Tender.

GEORGE J. McGREGOR,
County Clerk.
County Buildings,
Edinburgh.
29th June, 1931. 7203

Assistant Clerk of the Works.

APPLICATIONS are INVITED for the POST of ASSISTANT CLERK OF THE WORKS and RESIDENT ENGINEER in the Works Department at Guy's Hospital. The candidates must have a good practical experience of Generating of Electricity and Steam, Heating, Laundry and other Institutional Services. The application should be made in writing to the SUPERINTENDENT, stating age, present salary, experience, with copies of testimonials and references. Particulars of the duties of the post may be obtained on application to the Superintendent, Guy's Hospital, S.E. 1. 7206

Clerk of the Works.

APPLICATIONS are INVITED for the APPOINTMENT of CLERK OF THE WORKS at Guy's Hospital. The applications should be made in writing to the SUPERINTENDENT, stating age, present salary, experience, with copies of testimonials and references. Particulars of the duties of the post may be obtained on application to the Superintendent, Guy's Hospital, S.E. 1. 7205

SITUATIONS OPEN.

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

BOX No. 7098.—APPLICANTS for this Position are THANKED for their LETTERS and informed that CANDIDATES for interview have been SELECTED and NOTIFIED. 7212 A

CHIEF DESIGNER WANTED, with Experience on Commercial Vehicles. Must have special experience in getting out Designs for Low Cost of Production. Good progressive position for the right man. Give full particulars of training, experience, age and salary required.—Address, P1246, The Engineer Office. P1246 A

CRANE ENGINEER, with First-class Designing experience, combined with outstanding business ability. Must be able to Control a Large Staff and Produce Structural and Mechanical Designs so economical—yet thoroughly reliable—as to secure orders against the strongest competition. Good theoretical knowledge—not necessarily high mathematical attainments—which has been thoroughly tried out in practice essential. To the right man a substantial salary will be paid. Give full particulars of experience, which will be treated in strict confidence, and state age, which should be about 40, salary expected and when at liberty.
Address, 7214, The Engineer Office.
7214 A

ENGINEER SURVEYOR REQUIRED by Leading Engineering Insurance Office. Competent for Inspection of Lifts, Hoists and Cranes.
Salary £260 to £400.
State age (not to exceed 33), height, weight and full particulars of training and experience, with copies of recent testimonials.
Address, P1278, The Engineer Office. P1278 A

LARGE ENGINEERING FIRM REQUIRES Young METALLURGIST with works experience, for development of a process. Applicants should be university graduates, and state their metallurgical and engineering experience, age, salary expected, and supply copies of recent testimonials.—Address, 7154, The Engineer Office. 7154 A

MALE STENOGRAPHER WANTED for Engineering Dept. of Factory situated at Brentford. Only those with previous experience in an engineering office need apply. State age, experience and salary required.—Address, 7202, The Engineer Office. 7202 A

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PUBLIC NOTICE

Government of Bombay.

NOTICE.

TO IRRIGATION DEPARTMENTS, PORT AUTHORITIES, RAILWAYS, MUNICIPALITIES, ELECTRIC SUPPLY COMPANIES, PUBLIC WORKS CONTRACTORS AND OTHER ADMINISTRATIONS CARRYING OUT LARGE ENGINEERING WORKS.

Notice is hereby given that, owing to the approaching completion of the Lloyd Barrage at Sukkur, large quantities of Plant and Machinery as briefly detailed in the list below will shortly become available for sale. The bulk of the plant will not be available until after June, 1931, but some plant is now available and other plant will become available shortly.

All Administrations who have works in progress or who are contemplating works in the near future are invited to consider the subjoined list and to apply to the undersigned for full particulars and prices of any plant which might be of use to them. Enquiries are NOT invited from machinery dealers at the present stage. Most of the plant was purchased new for these works and is in excellent condition. Every item of plant sold will be first overhauled and put in thorough working order before sale and will be open for inspection (and test, wherever possible) by appointment at Sukkur.

Service will also be given after sale and purchasers' men will be trained by arrangements, as long as the Barrage Construction Works and Shops are in existence.

A. A. MUSTO,
C.I.E., M.I.C.E., I.S.E.,
Superintending Engineer, Lloyd Barrage Circle.
Postal Address: Sukkur, Sind, India. Cables: "SUKBAR, SUKKUR."

LIST OF PLANT & MACHINERY.

RAILWAYS.
About 40 miles of 5ft. 6in. gauge Railway complete and 9 Steam Locomotives and about 700 Wagons of all types, including 20-Ton Either-side Tipping Wagons. About 25 miles 2ft. gauge Railway complete and 15 Kerosine and 2 Steam Locos, and about 1100 Either-side Steel Tip Wagons of 27 cubic feet capacity.

FLEET.
Two Shallow-draught Suction Dredgers, by Lobnitz, 20in. discharge, to dredge to 30ft. each, complete with 1000ft. Floating Pipe Line and Terminal Pontoon with 150ft. overhang at 40ft. above water line.
Also Shallow-draught Paddle and Twin-screw Tugs, Motor Launches, Steel Barges, Pontoons, &c.
NOTE.—All motors on electrically driven plant are for A.C., 400 volts, 3-phase, 50 periods.

CRANES.
25-Ton and 10-Ton Electric Floating Derrick Cranes, 10-Ton and 1½-Ton Electric Derrick Cranes, 20-Ton and 2-Ton Steam Derrick Cranes. Also 5-Ton Steam Loco. Cranes and 10-Ton Electric Loco. Cranes, 5ft. 6in. gauge. Also 15-Ton, 12-Ton and 5-Ton Electric Goliath Cranes, 15-Ton Electric Shop Gantry Crane, and 15-Ton Hand-operated All-round Derrick Cranes.

PUMPS.
Sets of 8in., 4in., 3in., and 2in. Direct-coupled Electric Centrifugal Pumps for 40ft. head.

PILE DRIVERS.
Floating and Land Sets with McKiernan-Terry Double-acting Piling Hammers, Spencer-Hopwood Boilers, Zenith Winches and Steel Frames and Leads for driving 45ft. Piling.

STONE CRUSHERS.
"Acme" Jaw Crushers, 24in. by 15in., with Elevators, Hoppers and Screens and Portable Crusher, 12in. by 6in.

CONCRETE MIXERS.
Complete Plants for Moulding 10-Ton Blocks with Travelling Mixer Bridge carrying 2-Yard Ransome Mixers complete with Bunkers, Elevators and Batch Measuring Hoppers for materials, all electric driven. Also Steel Moulds for 10-Ton and 1½-Ton Blocks. Also Electric-driven Portable Mixers of sizes.

AIR COMPRESSORS.
Direct-coupled Electric-driven Sentinel Two-stage Compressors of 300 cubic feet capacity. Belt Drive Ditto of 550, 300, 188, and 140 cubic feet capacity respectively. Pneumatic Tools of all kinds.

DIVING GEAR AND DRESSES, &c.

ELECTRIC POWER PLANT.
Following Diesel Engines direct coupled to Alternators generating A.C., 6600 volts, 3-phase, 50 periods:—
2 Swiss Loco. 4-Cylinder Single-acting Diesels, 750 B.H.P., with Fly-wheel Alternator, 500 kW., by Oerlikon.
Metro-Vickers Cubicle Type Switchboard.
Johnson and Phillips Transformers, 6600 to 400 volts, of sizes.
H.T. and L.T. Overhead Transmission Poles, Cables, &c.

MORTAR MILLS.
Both Over-driven and Under-driven Type Mortar Mills, 8ft. dia. pans, with belt drive from countershaft.

WORKSHOP MACHINERY.
Lathes, Shapers, Planers, Milling Machines, Drilling Machines, Belt Air Hammers, Belt Hammers, Punching and Shearing Machines, Forges, Woodworking Machinery, Plate Rolls, Iron and Brass-foundry Equipment, Saw Sharpening Machines, &c.

QUARRY PLANT.
Compressed Air Drills of all sizes, Forging Machines, Oil Furnaces, Air Compressors, Oil Engines, Wire Saws, Channellers, &c.

STONE DRESSING PLANT.
Diamond Saws, Planers, Frame Saws, Rip Saws, Countershafts, &c.

ENGINES.
Oil Engines of various sizes.

BUILDINGS.
Steel-framed Stone Dressing Shop, 360ft. by 115ft., with 15-Ton Gantry Runway and numerous Smaller Steel Roof Trusses, &c.

STEEL SHEET PILING.
About 11,000 Tons "Universal" 15in. by 5in. by 43 lb. per square foot Interlocking S.S. Piling in 40ft., 45ft., and 50ft. lengths.

MISCELLANEOUS PLANT.
Such as Steel Riveted and Sectional Tanks of all sizes, with and without Staging, Winches, Jacks, Pulleys, Wire Ropes, Motor Lorries, and many other items.

A. A. MUSTO,
S.E.L.B.C.
MS.13/10. P.B. 40/30. 6445

DIRECTORS AND INVESTORS

OF

ENGINEERING & MANUFACTURING CONCERNS

are aware that the Incomes derived from their Investments have of recent years been so seriously reduced (in many instances become non-existent) and the **Capital Values** so drastically depreciated that Shareholders are more than ever critical of the actions of those responsible for the conduct of the businesses affected.

* * * * *

The duties of **Directors, Secretaries** and **Accountants** were never more onerous than now, and in their own interests, as well as the interests of those they serve, it becomes imperative for them to adopt every means to create and retain the confidence of their shareholders.

* * * * *

The day has definitely passed when loosely drawn up **Balance Sheets** will suffice.

* * * * *

Experience has taught the Investor how little reliance can be placed upon the **Value** of the Company's **Premises, Plant** and **Equipment** appearing in the **Balance Sheet "At Cost,"** or **"At Cost Less Depreciation."**

* * * * *

Such entries are meaningless—highly prejudicial—and may bear no relation whatever to **Present Values,** as everything depends upon the **Period** when the **"Cost"** was incurred.

* * * * *

The Company's Auditors do not (and cannot) certify the value of these assets, which calls for Expert Knowledge and Technical Experience.

* * * * *

With the ever-changing values that are taking place not only does Prudence Suggest but Necessity Demands that these values be **Periodically Adjusted by Competent and Unbiassed Experts,** whose Certification, in addition to relieving the Directors and Accountants of unnecessary and undesirable responsibility, creates among the Company's Investors that Feeling of Satisfaction and Confidence so essential.

* * * * *

The more closely this question of Periodical and Independent Valuations is studied the more must one become convinced of the need of their adoption.

* * * * *

A Full and Detailed Valuation is by no means necessary, as something less elaborate (at a Materially Reduced Cost) will satisfactorily answer every reasonable requirement.

* * * * *

May we submit our proposals? They have been acted upon by hundreds of our clients with Beneficial Results and will, without doubt, prove helpful to you.

* * * * *

For Over 80 Years we have specialised in this work, and the Cumulative Experience we have gained will be gladly placed at your disposal without obligation.

WHEATLEY KIRK, PRICE & CO.

(ESTB. 1850)

SPECIALISTS IN VALUATIONS OF
ENGINEERING & INDUSTRIAL WORKS & PLANT,

46, WATLING STREET, LONDON, E.C. 4.

SITUATIONS OPEN (continued)

LONDON BREWERY COMPANY Invites APPLICATIONS for the POSITION of RESIDENT CHIEF ENGINEER and ASSISTANT MANAGER of the WORKS DEPARTMENT.
Commencing salary about £700 per annum, with house rent free.
Candidates must be thoroughly qualified Mechanical Engineers, accustomed to the erection and maintenance of Steam, Electrical and Refrigerating Plant and with experience in Supervision of the Construction, Maintenance and Repair of Factory Buildings.
Address, P1268, The Engineer Office. P1268 A

MANAGER REQUIRED, to Control Constructional Steel Work Establishment. Must have expert knowledge in fabrication of materials in workshop, erection on site and production costs, also in negotiating contracts for all classes of constructional steel work.—Address, stating age, experience, salary required, and enclose copies of testimonials, 7134, The Engineer Office. 7134 A

DRAUGHTSMAN WANTED.—A Firm of Consulting Engineers in Westminster have VACANCIES for DRAUGHTSMEN accustomed to Detailing Steel Bridgework and Structural Steel Work.
Address, stating age, experience, salary required, and when at liberty, P1283, The Engineer Office. P1283 A

WANTED, FOREMAN, to Take Charge of Well-arranged Foundry in the South Midlands handling Steam Cylinders and Pumps and High-class Engineering Castings; knowledge of Modern Foundry Methods essential.—State age, experience, and wages required to Box 106, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, E.C. 4. 7192 A

SITUATIONS WANTED.

CAPABLE EXECUTIVE, Age 35, Thoroughly experienced Sales Engineer, Cost Estimator and Quantity Surveyor, at present actively associated with New York manufacturer, WISHES to RETURN to GREAT BRITAIN and SEEKS a POSITION of IMPORTANCE with a BRITISH FIRM engaged in the Manufacture of Metal Products used extensively in the Building Industries.
Have had considerable experience securing architects' specifications and closing large contracts with construction companies.
Specialist in steel, bronze and aluminium window sash, metal trim and doors, &c., also composition and rubber floorings.
Write direct to GAVIN LIDDELL, 2016, Regent-place, Brooklyn, N.Y., U.S.A. P1271 B

CHEMICAL ENGINEER, 32, Single, DESIROUS of REPRESENTING FIRM on Solvent Recovery Installations. Ex. ref. Home and abroad as Erecting Supervising Engineer, Plant Layout, General Engineering.—Address, P1276, The Engineer Office. P1276 B

CIVIL ENGINEER DESIRES APPOINTMENT; 20 years' experience survey, construction, maintenance railways abroad; speaks Spanish and Portuguese.—Address, P1269, The Engineer Office. P1269 B

COMPETENT ENGINEER (Age 39), Mechanical and structural, varied experience works and designing North England. Held positions [chief engineer, manager, structural engineer and sales; liberty end June. London and district only. Salary moderate.—Address, P1234, The Engineer Office. P1234 B

ENGINEER (23½ Yrs.) SEEKS JOB ABROAD. Apprenticeship with rly., 2 yrs. college, passed Parts A and B of the A.M.I.C.E. exam., loco. running dept. D.O., and engaged on inspection of materials.—Address, P1267, The Engineer Office. P1267 B

ENGINEER (36), Extensive Experience of Modern production methods for the manufacture of small accurate mechanisms, electrical and mechanical, used to control of all classes of labour, several years in managerial positions, DESIRES POST as Works Manager or Production Manager.—Address, P1248, The Engineer Office. P1248 B

ENGINEER REPRESENTATIVE, first-class London and Home Counties connection, REQUIRES SITUATION. Disengaged when suited.—Address, P1292, The Engineer Office. P1292 B

MECH., CONSTRUCTIONAL and RAILWAY ENGINEER SEEKS POST, design, works, commercial, positions held, good organiser; home or abroad; age 44, speaks Spanish.—Address, P1253, The Engineer Office. P1253 B

POSITION REQUIRED, Age 39, Past Experiences foreman, ship and boiler repairs in England; 5 years locomotive boiler inspector in two main roads in U.S.A.
Foreman in structural steel, steel jails and general steel department.
Superintendent of locomotive syphon shop, blacksmith shop, carburizing and hardening room in U.S.A.
Capable of handling any number of men. Please state salary.
Address, P1285, The Engineer Office. P1285 B

TO DIESEL ENGINE MANUFACTURERS, AGENTS OR USERS.—Experienced ENGINEER, G.M.I. Mech. E., aged 29, thorough practical training design, manufacture, testing, experimenting, installation, maintenance and works management, highest references, now FREE for ENGAGEMENT. Please inquire for particulars.—Address, P1290, The Engineer Office. P1290 B

WORKS MANAGER, with 20 Years' Experience in one of the largest Manufacturing Firms in this country, DESIRES POST. Noted organiser, prepared take Full Control Purchases and Supervision Stores, Rolling Stock, &c.—Address, P1288, The Engineer Office. P1288 B

DRAUGHTSMAN-ESTIMATOR (28), 3 Years Tech. School, 10 years works and D.O., steel melting furnaces and rolling mills, general engineering, gas producers, water softening and filtering plant, erection supervision, REQUIRES PROGRESSIVE POST.—Address, P1274, The Engineer Office. P1274 B

EXPER. MECH. DRAUGHTSMAN UNDERTAKES TEMPORARY WORK, London district, by hour, day, or week.—Address, P1265, The Engineer Office. P1265 B

JUNIOR DRAUGHTSMAN (Constructional), Age 22 years, 7 years' experience in D.O., detailing and designing beams, stanchions and roof trusses.—Address, P1289, The Engineer Office. P1289 B

REQUIRED, SITUATION as DRAUGHTSMAN, ESTIMATOR or REPRESENTATIVE in or near London; 24 years' continuous D.O. experience on machine tools, centrifugal pumps, plant lay-out; full details on request.—Address, P1275, The Engineer Office P1275 B

For continuation of Small Advertisements see page 4.

JULY 3 1931.—VOL. CLII.

THE ENGINEER.

A Seven-Day Journal

Harland and Wolff, Limited.

SPEAKING at the annual general meeting of Harland and Wolff, Ltd., recently, Mr. F. E. Rebbeck, chairman and managing director of the company, gave some interesting figures. He said that it would interest his audience to hear that there were now 650 vessels having a gross tonnage of over 3,700,000 and developing an indicated horse-power of nearly 2,600,000, equipped with the Burmeister and Wain type of engine, the work of the company upon the development of which was well known to them. The firm had recently had at the works in Belfast undergoing overhaul three vessels fitted with engines of the B. & W. type, which had given uninterrupted and satisfactory service for seventeen years, and had been assured by their owners that, reckoning from the past history of the engines, they could be expected to last another ten years. As an indication of the depth of the present depression and the rapidity with which it had developed in the last year, Mr. Rebbeck stated that when the industry was fairly well occupied in 1923 the firm gave employment throughout its organisation to about 48,000 men. At the beginning of 1930 that number had fallen to 44,000, while by the early part of 1931 the latter figure had been halved; that is to say, that only 22,000 men found employment with the firm. Those figures included men employed by the firm's subsidiary shipyards, steel works, and collieries. Mr. Rebbeck later referred to the possibility of the question of a writing down of the fixed assets and the desirability of giving consideration to a scheme for reorganising the capital, to which reference was made in this column on June 19th.

Electricity Charges.

WHILST opening the new electricity showrooms at Hammersmith on Friday, June 26th, Mr. F. W. Marchant, the Chairman of the London and Home Counties Joint Electricity Authority, referred to the fact that the supply undertakings of the London and Home Counties had refused to consider uniform charges for current and apparatus. Within the district which came within the jurisdiction of his authority there were ninety supply undertakings, each of them having its own particularly designed form of tariff for various classes of consumers, so that there were in fact hundreds of different tariffs in existence. In that respect the electricity service stood alone among the great public utility services of the day. Water, gas, traffic, and all such services throughout London, and particularly throughout London and the Home Counties, were charged to the public on uniform and well-known bases, so that the public knew exactly what it had to pay and what service it got in any part of the district. There was need for steps to be taken towards uniformity in the methods of charging for electricity and the hire of installations and apparatus, and the authority proposed to discuss the matter with the Minister of Transport and the Electricity Commissioners.

The Approaches to Southampton Harbour.

IN a number of notes on this page during March and April we recorded the fact that demands were being put forward that the approaches to Southampton Harbour should be improved. Several mishaps to large liners had occurred there recently, and with the building of the new Cunarder and the provision of new and extended docks, it was considered in some quarters that improvements were necessary. Last Thursday, June 25th, the Southampton Harbour Board decided to take some steps to improve the light and provide a fog signal at Fawley Beacon. Trinity House, with its great experience, is to be asked for advice on both these matters, while a report on the condition of the structure is to be made. In addition, it was decided that Trinity House should be requested to alter the timing of the fog signal at Calshot lightship so that it should sound every minute instead of every two minutes, and that the Southern Railway Company should be invited to install a fog signal at the docks. Although outside its jurisdiction, the Board considered that improvements might be effected in the areas of the Needles and the Nab, similar to those suggested recently at a conference with shipping representatives. In consequence, it decided to inform the Board of Trade and Trinity House that it considered the provision of efficient fog signals at Hurst Castle and the Solent Bank, and the improvement of that at the Needles, necessary, while urging at the same time that conditions at the Nab would be improved by installing a wireless direction finder, a submarine oscillator and an efficient fog signal. A letter was read at the meeting from the Mercantile Marine Department of the Board of Trade stating that the Department was in communication with the Corporation of Trinity House with regard to the lighting of the channel.

French Shipbuilding.

THE annual report of the French Association of Shipbuilders and Marine Engine Builders states that last year merchant shipping only provided French yards with orders for two cargo boats and an oil tanker. There is, however, an optimistic tone about the future, for it is affirmed that the present shipping depression cannot last indefinitely and must be followed by a period of great activity. In France only about 11 per cent. of the ships are less than five years old, and the country is so far behind with the construction of motor vessels that, when the revival takes place, there should be plenty of work for French shipbuilders. The present time should, therefore, be employed on a work of reorganisation so that the yards may be in a position to keep all the home business and secure foreign orders, which they are now unable to do on account of their high costs. The reorganisation has already begun with the grouping of all the shipyards into a National Union of Naval Construction in order to carry out the recommendations of the National Economic Council for a rationalisation of the industry. Shipbuilders are now waiting for the Government to execute its part of the agreement and introduce a Bill into Parliament which will establish definitely the conditions of State protection and encouragement whereby French shipbuilders will be placed on a level with their foreign competitors. Something has already been done by an extension of the Crédit Maritime to ships built in French yards, but fitted with imported engines, which provides for State loans to shipowners up to 85 per cent. of the cost of such ships. So long as loans did not cover ships with foreign internal combustion engines owners had often to send their orders abroad. This extension of credits does not, however, satisfy French marine engine builders, who affirm that they can supply solid-injection engines of any power and as good as foreign engines.

Oil Fuel.

LAST Wednesday, July 2nd, a deputation, representing the interests of South Wales and Monmouthshire, and headed by Mr. R. G. Hill Snook, Lord Mayor of Cardiff, presented a petition to the Admiralty. It was stated in the petition that the signatories believed that the national security would be strengthened if the Navy reverted to the use of coal as a fuel and pointed out that a large part of the Army, the Air Force and the Merchant Marine was absolutely dependent on a sustained supply of oil, which came from foreign countries and was carried great distances by sea. The Navy, which was responsible for the defence of the sea routes along which the oil was brought, was itself dependent upon the fuel it was protecting. The petitioners, after stating that a reversion to the use of coal in the Navy might restore 16,000 persons to profitable employment, proposed that every ship in the Navy should be converted as soon as possible to coal burning, and that all new construction should be arranged in the same way. In reply, Mr. Ammon, Parliamentary and Financial Secretary to the Admiralty, said that the question whether ships should burn oil or coal had been very carefully considered, and oil burning had not been adopted without a very thorough trial. Experience in the war had shown the advantages of oil as a fuel. He pointed out that if the British Navy were to burn coal while foreign navies did not, the displacement of our ships would have to be relatively higher, which, considering the limited tonnage figures fixed by agreements with foreign Powers, would be a great disadvantage. Although the fact that oil had to be obtained from abroad was a great disadvantage, the military advantages of oil fuel were considered to outweigh that disadvantage. Excepting only America and Russia, other naval Powers were in the same position.

Grit from Electricity Works.

NOTWITHSTANDING that from time to time the Birmingham Electricity Supply Committee has given much attention to methods of overcoming, or, at least, substantially reducing, the emission of grit from the chimneys of its generating stations, according to a report from the engineer, presented at the last monthly meeting of the Committee, a complete cure for the trouble has not yet been found. Up to the present the "grit" eliminating installations have cost no less than £113,000, but, apparently, they have not proved completely satisfactory. The Committee is, however, hopeful that the result of investigations recently made by a committee of expert engineers and chemists may indicate ways and means by which any cause for complaint in this connection may be removed.

Steam Driven Lorries.

THE Minister of Transport has just issued the Motor Vehicles (Construction and Use) Amendment Provisional Regulations, 1931, which make certain minor amendments in the Motor Vehicles (Construction and Use) Regulations, 1931, and in addition modify the provisions as to maximum permissible laden weights of four-wheeled heavy motor cars propelled by steam. This modification has been made as a result of representations which the Minister has received from the Mining Association of Great Britain and from users of heavy steam wagons that, owing to the weight of water and fuel carried by steam vehicles, the paying load is smaller in proportion to the total weight than in the case of a petrol-driven vehicle. The effect of the modification is that the existing total weight of 12 tons allowed by the Regulations for four-wheeled heavy motor cars, whether propelled by steam or petrol, is increased in the case of such vehicles when propelled by steam to 14 tons if the vehicle is registered under the Roads Act, 1920, before January 1st, 1932, provided that its maximum speed with or without a trailer does not exceed 12 m.p.h. and if the vehicle is registered on or after that date to 13 tons, provided that it is fitted with pneumatic tires on all wheels.

The Carlisle Railway Accident.

ON Wednesday, Lieut.-Colonel A. H. L. Mount issued his report to the Ministry of Transport in connection with the train derailment at Carlisle on January 3rd. It will be remembered that an L.N.E.R. passenger train travelling from Edinburgh to St. Pancras was derailed at a curve, with the consequence that four coaches were wrecked and three persons killed. Colonel Mount reports that the accident occurred owing to the engine leaving the track at a speed of not less than 45 m.p.h., which was at least three times the restricted speed imposed. Primary responsibility, therefore, rested upon driver Eskdale. There was no technical reason why he should not have taken his train round the curve at a safe speed, and his failure was the outcome of a lack of judgment of speed, coupled with over-confidence and, perhaps, some anxiety to recover time previously lost. Recommendations are made that the question of fitting speed-indicating instruments on the footplate should be considered, and it is pointed out that owing to the increased necessity for acceleration, concurrent with increased weight and hauling capacity of locomotives, an increasing number and variety of restrictions must be observed. In consequence, further consideration appears to be desirable with regard to the use of indicators or boards on the track to define where necessary the location of permanent speed restrictions.

The Liverpool-East Lancashire Road.

ON June 11th, members of the Highways and Bridges Committee of the Lancashire County Council made an inspection of the new road which is being constructed between Liverpool and Manchester. To mark the occasion, the Resident Engineer, Mr. Henry Swire, prepared a brochure describing the undertaking, and from that publication we abstract the information given in what follows.

The question of how best to improve the road communication between the two great Lancashire cities had been under discussion as long ago as 1912, but nothing was actually done until after the war was over. Thereafter, however, a tentative proposal was made for the construction of a road, which would have taken a line to the south of that now actually being formed, and would have led directly to the Manchester Ship Canal Docks in the City of Salford. Towards the cost of carrying out of that suggestion, the Ministry of Transport expressed itself as prepared to contribute 50 per cent. of the total, provided that contributions to make up the balance were received from the various local authorities which would be interested either directly or indirectly or both. Later, the amount of the Ministry's contribution was raised to 75 per cent. of the total, since several authorities withdrew their promise to contribute. Actually, the authorities contributing to the cost—in addition to the Ministry—are: The Mersey Docks and Harbour Board, the Corporations of Liverpool, Bootle and St. Helens, and the Lancashire County Council. The first suggested route for the road, however, was not eventually followed, since it was agreed that an alternative line further to the north was preferable.

By the middle of June, 1927, Mr. Swire had set up his headquarters at Newton-le-Willows, as well as four Section offices, and the survey of the final and approved line was being carried out. For administrative purposes, the road is divided up into five Sections, each under the charge of a Sectional Engineer. The route to be taken by the road is shown by the broken line in Fig. 1. It will not materially shorten the distance between Liverpool and Manchester, but it will afford a very materially improved means of road transport between the two Cities. The existing road passes through towns and is tortuous and exceedingly narrow in places. The carriageway in the Borough of Warrington and in the Urban District of Prescot—to take two examples—is little more than 15ft. wide, and considerable delay to traffic is frequently experienced. It was because it was considered almost impracticable to widen this road, owing to the very large expenditure that would have been incurred in acquiring the valuable property abutting on it, that the new road was undertaken.

The existing road is 34¾ miles long from Town Hall to Town Hall of the two Cities. The new route—see Fig. 1—between the same points is 34 miles long, and it passes through part of the City of Liverpool, one non-County Borough, five Urban Districts and three Rural Districts. Two and a-quarter miles of it lie within the City of Liverpool, and that length has already been completed. There is a length of ¼ mile within the County Borough of St. Helens, and the length within the area of the Lancashire County Council is 24¾ miles. The total length which is being constructed under the present contract is 25 miles 14 yards.

The width of the new road is to be 120ft. between fences. There is to be a central carriageway, 40ft. wide, and the remaining land on each side of it is reserved for the forming of subsidiary roads when the need for their construction arises. The ruling gradient is 1 in 40, and the flattest gradient 1 in 400. Provision has been made on the extreme flanks for the laying of public service mains, while overbridge chases have been left in the decking where there is insufficient cover. The total area of land that will have to be purchased is about 500 acres. On the line chosen for the road, there were 135 houses which had to be demolished, and 69 houses have already been erected to provide alternative accommodation for dispossessed tenants. In addition, compensation was paid to owners whose property was acquired and to tenants who have found their own alternative accommodation.

In the length of the road there are 99 culverts under 4ft. in diameter, all of which are circular reinforced concrete pipes surrounded by 6in. of 1–2–4 cement concrete. In addition, there are nine box culverts in monolithic reinforced concrete, with spans under 15ft. There are five bridges under 25ft. span; two under 35ft. span; one of 45ft. span, and one of 60ft. span. In addition, there are to be thirteen bridges over railways and canal, which have been designed and are being carried out under the supervision of Messrs. Mott, Hay and Anderson, of Westminster. The bridges have a width, between parapets, of 80ft., and all of those which are being erected to Mr. Swire's design and under his supervision are, with the exception of the reinforced culverts, being built with stone abutments and parapets and with steel superstructures, or with reinforced concrete decks. In their construction, difficulties have been met with in the foundations, and not only are many of them standing on reinforced concrete piles, but it has also been necessary to enclose the subsoil in steel sheet piling in order to prevent lateral spread and to obtain the proper set on the concrete piles. The bridges which are being built over railways are of mass concrete faced with pressed bricks, with steel structures and reinforced concrete decking.

Nineteen miles out of the entire length of the road lie over the Lancashire coalfields, many of which are, at the moment, in active operation. It is, therefore, to be expected that subsidences will, from time to time, occur over certain areas. In one section, —No. 3—the land is particularly low-lying, and if and when subsidence takes place there will, no doubt, be flooding there. In order, therefore, to neutralise the effect of the subsidence, the whole of the road in that section has been formed upon an embankment, which varies in height from 4ft. to 7ft., and that has necessitated the bringing to the site of some 1,000,000 cubic yards of borrowed material. The amount of soil which has been or will be excavated is approximately 1,500,000 cubic yards, and the whole of it will be consolidated in the embankments in 3ft. layers. The generality of the cuttings that have to be made vary in volume from 35,000 to 90,000 cubic yards, but at Windle Hall in Section No. 1—see Fig. 2—there is a cutting from which 295,000 cubic yards are being removed.

The draining off of surface and subsoil waters is receiving particular attention. A system of surface water drains has been laid on each side of the carriageway at a distance of 7ft. from the kerb line, and side entrance gullies have been arranged at intervals of 40 yards apart, each gully communicating with the surface water drain. In addition, about 50 miles of agricultural drain pipes have been laid for the purpose of carrying off the water from the surrounding lands. As, in most cases, the fall of the land is from north to south, the land drains are made to discharge into a master drain laid immediately outside the fence, which communicates with the nearest stream. Manholes have been arranged at every bend and change of gradient in the surface water drains, so that, should the latter become blocked, they may readily be rodded and cleaned out. The least radius of the road on plan is ¾ mile, and it has not been necessary to superelevate any portion of the road. The vertical curves are all worked out to a proper radius, and the minimum in the valleys is 15,000ft. and on the summits 8000ft. radius.

The carriageway is being constructed by laying on the subsoil—previously formed to correspond with the contour of the finished surface—first of all, 6in. of consolidated clinker, and then a depth of 15in.

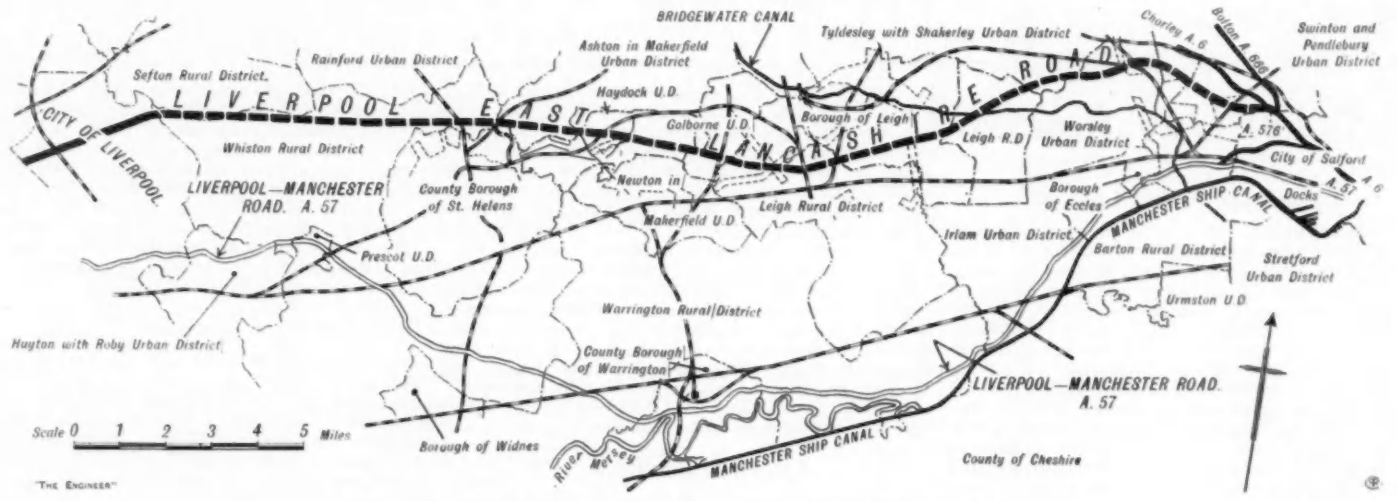


FIG. 1—ROUTE OF THE LIVERPOOL-EAST LANCASHIRE ROAD

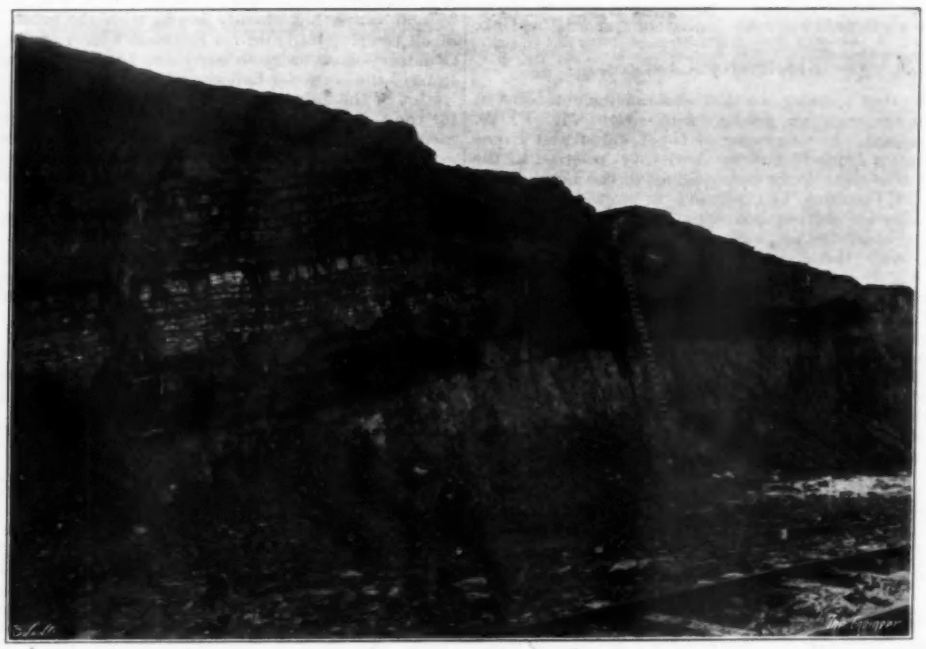


FIG. 2—WINDLE HALL CUTTING

of double reinforced concrete. The "mix" is of the proportions of 1–1½–3, the aggregate being ¾in. to ⅛in. graded granite chippings, and the sand being the screenings of the granite—⅛in. to dust. The total area of the carriageway is approximately 614,700 square yards, which represents—with a depth of 15in.—roughly a quarter of a million cubic yards of concrete. Each consignment of cement is being tested and the mixing and testing of the concrete is being particularly attended to. For compression strength a standard of not less than 3200 lb. per square inch at 28 days is aimed at, but, actually, so we gather, the records show that the average attained is just over 4000 lb. per square inch at 28 days. Mr. Swire attributes that satisfactory result partly to the good quality of the cement used, partly to the honesty of the contractors, and partly to the cleanness of the aggregate, and more particularly of the ⅛in. to dust grit.

At every important road junction—and there will be 24 of them in all—there is to be a large circus, with a radius of 120ft., so that the drivers of vehicles will have a clear view for a considerable distance before approaching a cross road.

The estimated cost of that part of the road which is entirely within the Administrative County and the County Borough of St. Helens is as follows :—

Road works and bridge works for the completed scheme	£2,062,528
Land and property	184,400
Permanent fencing	37,568
Transport of workmen	80,000
Amount reserved for surfacing	250,000
Establishment	80,000
Total	£2,694,496

That figure does not include the cost of constructing the 2¼ miles within the City of Liverpool, but it is estimated that the whole scheme, including that portion, will cost £3,000,000. The work is being carried out under Section I. of the Unemployment (Relief Works) Act, 1920, and one of the conditions is that the unskilled labour shall be recruited through the various Labour Exchanges along the line of the road. The County, by arrangement with the Ministry of Transport, invited tenders from eleven firms which were considered competent to carry out the work in one contract. Eight tenders were received, and that of Sir Lindsay Parkinson and Co., Ltd., the amount of which was £2,147,179, was accepted. The amount is, of course, exclusive of the acquisition of land and property, nor does it include the cost of fencing, transport of workmen, and surfacing, nor the establishment expenses.

By the courtesy of Mr. Swire we are enabled to give herewith and on page 12 reproductions of a series of photographs of different parts of the works.

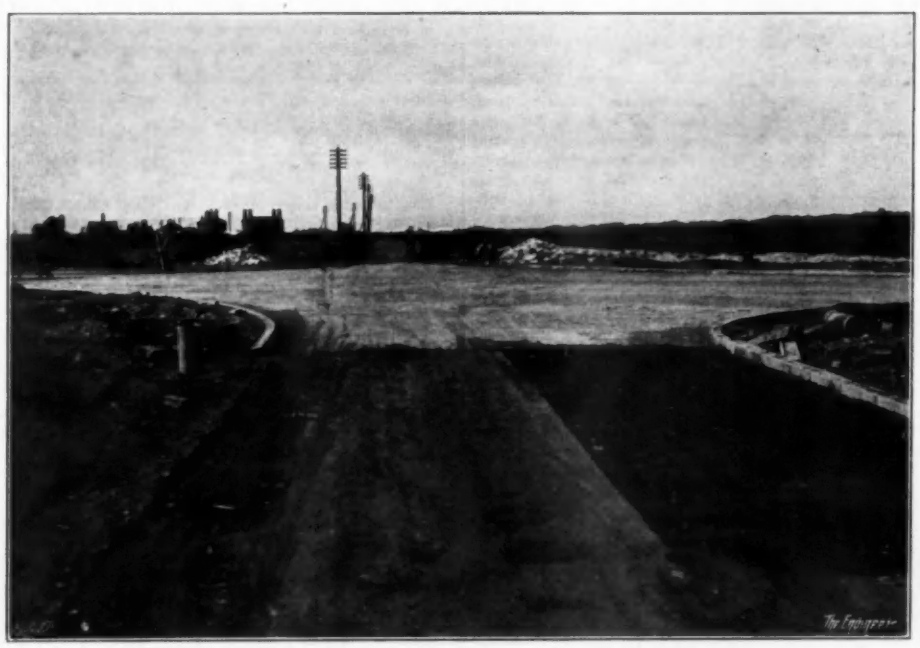


FIG. 3—FORMATION OF A "CIRCUS"

THE steam tanker "Maracay," a shallow-draught vessel built by Harland and Wolff, Ltd., for the Lago Shipping Company, Ltd., which has now been handed over to her owners at Belfast, is the twenty-first tanker of this type built at Belfast for the Lago Shipping Company. She is, however, slightly larger than the previous vessels, her dimensions being 350ft. b.p. by 60ft. beam by 17ft. 6in. depth moulded, with a gross tonnage of 3794 tons. The ship is classed 100 A1 at Lloyd's, being specially designed for the carriage of petroleum in bulk. The service upon which the "Maracay" will be engaged is a most interesting one, and depends upon the fact that petroleum produced in the Lake Maracaibo Basin is of no practical value until it has been transported to a deep-water harbour for ocean shipment.

Flowing Water.

No. IV.*

By J. M. LACEY.

CANALS.

THE large rivers of India where they debouch from the hills into the plains flow between alluvial banks or margins. Every time such rivers overflow their banks by inundation they deposit alluvial matter, which forms a concomitant part of what all rivers carry, in the form of a wedge with its butt more or less on the bank of the river, and its edge tapering out into the plain, so that gradually the rivers build themselves up, and incidentally embank themselves within certain limits.

The beds of these rivers consist of sand, the sand often extending to considerable depths, and being generally found charged with water up to or near the surface, even in the dry season. Owing to variation in flow, shoals or sand banks are formed where the current divides, and these shoals have an apparent motion downstream, owing to the flood water eroding the nose of the sand bank and depositing the eroded sand in the dead water behind. The rate of apparent motion depends on the grade of sand, and the volume and the velocity of the flood water.

Silt.—By silt in this article is meant the sandy particles of matter which are carried or swept along the beds of rivers, streams, and canals, as distinguished from the alluvial clay matter and mud, which is easily moved and is carried along in suspension, causing the water to appear turbid, and which settles only in still water or in sheltered places.

As already stated—THE ENGINEER, May 23rd, 1930, page 571—the deep or cold weather channel of these rivers oscillates in regular waves in the sand beds, the waves gradually moving downstream.

As an example, in the case of the irrigation channels taking off from the Naganalli River in the Gangam District of the Madras Presidency, South India, the channels were first excavated where the deep water hugged the margin—sketch, Fig. 1—at A. In course of years the native cultivators found that the deep channel of the river had moved downstream, and therefore during low water an approach channel had to be excavated through the sand bed from the deep water of the river to their irrigation channel. As the deep water moved further down the river, there came a time when the deep water was on the opposite bank, and the head of the irrigation channel was blocked by a high sand shoal. The obvious course, which the native cultivators adopted, was to open a new head further upstream, as shown at B, Fig. 1. The supply to the channel was thus worked between these two heads, which might be several miles apart. According to village tradition, the period of oscillation for this particular river was thirteen years. The channels had open heads, and the sand entering them was periodically cleared by the interested cultivators, those owning land at the tail end of the channel generally doing the greater part of the work, as their lands depended on an ample supply coming down the channel.

Further south a different method is adopted. In the case of the Cauvery River channels, above Siringam Island, the Aganda Cauvery is so wide that two heads to an irrigation channel would be a prohibitive distance apart. The practice is to construct a side or loop channel from the main river—*a*, *b*, sketch, Fig. 2—from which the irrigation channel *c* takes off. This procedure limits the silt clearing to the loop channel, only a small quantity of sand passing down the irrigation channel. So long as the deep channel of the river hugs the margin from which the loop channel takes off the supply is ample; but if the deep channel of the river is some distance from the loop channel head, a "corombu" or low bank of sand, some 2ft. or so in height, protected from wash by branches of trees and twigs, is constructed from the loop channel head to the deep channel of the river—Fig. 2. The excavation in the sand bed of the river for the "corombu" forms the supply channel from the deep channel of the river to the loop channel head.

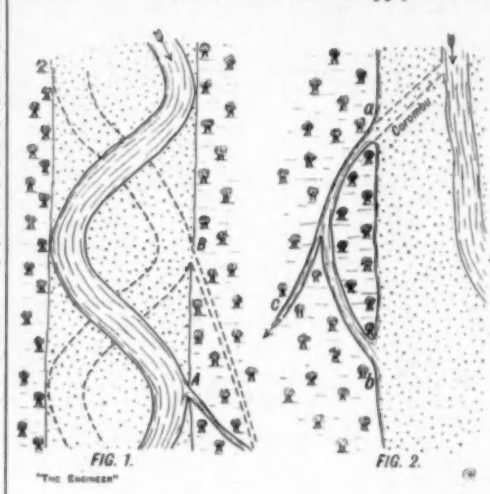
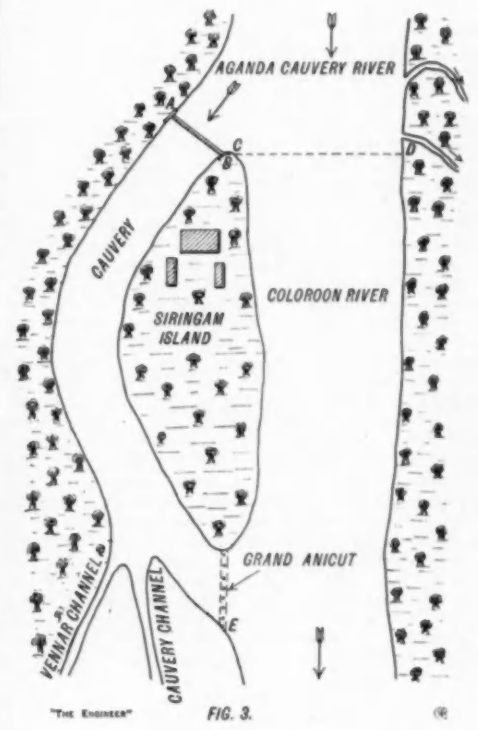


Fig. 3 is a diagram of the Cauvery River at the island of Siringam, near Trichinopoly. The Aganda Cauvery, as it is called above Siringam, here divides into the Cauvery and the Coloroon. The Cauvery was evidently in former years a loop channel, as described above, and in course of time widened and deepened itself to the proportions of a river. There was a fear that it would enlarge to such an extent as to drain the Coloroon. To prevent further erosion, Sir Arthur Cotton, somewhere about 1854, built a bed regulator across the Cauvery head, consisting of a broad-crested weir, at the mean bed level of the river, provided with wing walls—A B, Fig. 3. This has stopped further erosion. Further down, two irrigation channels the Vennar and the Cauvery take off and ramify over the Tanjore District, irrigating a million acres of paddy land. Where the Cauvery tails into the Coloroon is an old native structure, the Grand Anicut—E, Fig. 3—built to hold up supply to the Cauvery and Vennar channels, which has now been improved and fitted with shutters. Head sluices have been built to the Vennar and Cauvery channels, and a vented anicut has been built across the Coloroon—C D, Fig. 3—to steady the supply to the Cauvery and the irrigation channels on the left bank of the Aganda Cauvery.



When the Public Works Department was formed in India, the more important of the irrigation systems came under its charge. In the case of the larger

* No. III. appeared August 29th, 1930.

canals, and in that of new irrigation projects, the principle adopted was to construct an anicut or low dam across the river concerned, in order to raise the dry-weather supply in the river to a height sufficient to maintain full supply in the canal taking off above this anicut. The canal was also provided with a head sluice, to prevent inundation and damage to the canal when the river was in flood.

It was soon found that the head reaches of some canals silted badly, some to a small extent, and some hardly at all. There was a good deal of controversy as to the cause of these differences, the reason, at one time, being ascribed to the direction in which the canals "took off" from the parent river. It was also observed that some canals which silted badly improved, and other canals previously free from silt began to silt in their head reaches. However, notwithstanding these observations, silt clearance in the head reaches of canals became a recognised annual maintenance work.

About 1892, Major Smart, R.E., pointed out that after a canal had been cleared to its original section, during the dry weather closure, the first flood coming down the river silted up the head reach so that little or no advantage was gained by the clearance. He also observed that the level of silt in the canal was constant, *i.e.*, the depth deposited did not increase with the duration of floods. He noted also that the slope of the new silted beds of the canal was slightly greater than that of the canal as originally excavated. This condition he termed the "normal silt level," and advised that further silt clearance in canals should be discontinued, and that if under these conditions a canal was not carrying its required supply it should be widened.

Various expedients were tried in order to ascertain if, by any means, the sand could be kept out of irrigation canals. One proposal was, after clearing a canal to its original designed section, to block the head sluice with dry stone packing to the ascertained "normal silt level," the idea being that the sand would be held back while the water would

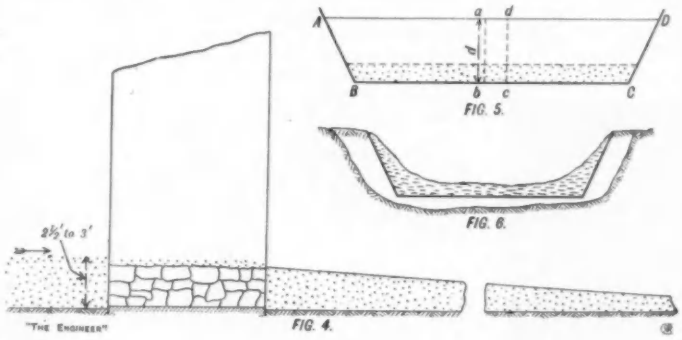


FIG. 4.

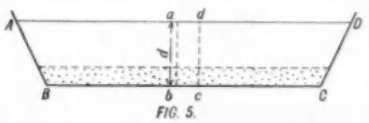


FIG. 5.

FIG. 6.

percolate through the interstices of the stone packing. Such an experiment was carried out at the Central Delta head sluice, Godavery Anicut Irrigation System (*vide* sketch Fig. 4). When the canal was cleared of silt during the dry-weather closure, the vents of the head sluice were packed with dry stone to the normal silt level in the canal. It was anticipated that the sand would be held back by the dry stone barrier. The result was not as anticipated. As the river began to rise the sand soon filled up in front of the barrier, and when the water was low the top surface of the sand was seen to be swept over the barrier, falling into the canal downstream of it. As the river rose it was not possible to make further observations, and during the next closure it was observed that the canal had silted again to its normal silt level—Fig. 4. In the Madras Presidency the "normal silt level" was recognised, and further silt clearing in the head reaches of canals was stopped. The distance this silt would eventually travel down a canal if not cleared remains yet to be ascertained. It is now recognised that if deep water can be obtained in front of a canal head it does not silt, and that the silt level in a canal is the level of the sand or sand shoal of the parent river at the canal head. Also, as the main stream of a river in time alters its course, the position and level of the sand shoals alter; and this fact accounts for the changes in the level of silt deposits observed in some canals.

If there be deep water in a river at the head of a canal, unless the velocity of entry to the canal is so great as to disturb the sand at the river bottom, only the lighter particles of an alluvial nature, which are held in suspension, will be carried into the canal, and will eventually be passed on to the land, thus fertilising it. It is undesirable to pass the coarse sand of South Indian rivers on to the fields. The coarse sand has no fertilising properties, and is certain to inflict damage on cultivation.

The velocity necessary to disturb sand in a river or stream bed and move it forward is some function of the depth of the water. Dr. Deacon, in his experiments, showed that when the surface velocity was 1·3ft. per second sand movement was confined to small grains, which arranged themselves in sand ripples, the ripples having a slow forward movement. When the surface velocity reached 2·125ft. per second the ripples became more irregular. In the "Third Phase," when the surface velocity exceeded 2·9ft. per second, the particles of sand were raised in suspension, and rushed along with the water ("Proc." Inst. C.E., Vol. CXVIII.). The sand is stated to be the river Mersey sand, and the depth of water 8in. No observations appear to have been made in order to ascertain if the depth of water had any influence on the velocity necessary to move the sand as above described. Dr. Owens states that in the case of ordinary sea sand, composed of quartzite grains $^1/_{80}$in. to $^1/_{100}$in. in diameter, the grains would begin to move when the current obtained a velocity of 0·85ft. per second, and from velocities of 0·85ft. to 2·5ft. per second the sand would move in ripples. When a velocity of 2·5ft. per second was exceeded the ripples were swept away, the sand was raised in suspension an inch or two from the bottom, and was carried away extremely rapidly in a smooth sheet rushing over the bottom with almost the same velocity as the current ("Proc." Inst. C.E., Vol. CLXXXIV., page 199). The velocities measured were apparently velocities at, or near, the bottom. Dr. Owens does not give the depth of water in which these observations were made.

Mr. Kennedy states that the velocity required to carry silt forward in a canal is some function of the depth ("Proc." Inst. C.E., Vol. CXIX). There appears to be some confusion as to the application of his formula. In the case of a canal A B C D, Fig. 5, Mr. Kennedy apparently considered that for the class of sand met with in the Panjab rivers the velocity sufficient to sweep it along a canal bed, say, in accordance with Dr. Deacon's "Third Phase," was given by the equation

$$v = 0 \cdot 84\, d^{0 \cdot 64},$$

where v is the mean velocity of the cross section and d the depth of water. His formula is based on the idea that the strength of the vertical eddys on each square foot of canal bed depend on the mean velocity of the canal, and these eddys support the silt in a volume of d cubic feet above it. The banks and the bed of the canal, being of quite a different material from the sand brought in from the parent river, would naturally scour if the velocity was sufficient to rupture the molecular bonds of the soil in which the canal was excavated; hence Mr. Kennedy limited the depth of his canals so that the velocity as obtained by his formula did not exceed about 3·5ft. per second; the limit of velocity for Panjab soils. If the soil was of a more tenacious character it is obvious that the limiting depth could be increased.

It has been stated that Mr. Kennedy's formula "defined a 'channel with a single constant' gradient. . . . . If a canal is made with this gradient, the depth of flow for stable conditions may have any desired value"—"Proc." Inst. C.E., Vol. CCXXIX., pages 343–344. This statement appears to be in agreement with conditions obtaining in the irrigation systems of the Panjab. In the case of the Chenab Canal Project, Panjab, Mr. Preston states that the main canal and the larger distributaries were given a longitudinal slope of 1 in 6250—0·16 per thousand. He also states that in the last 12 miles of the main canal the original slope of 1 in 5000 had to be flattened by the introduction of masonry rapids, the limiting velocity being 3ft. per second. Mr. Preston also states that from statistics maintained of the supply which entered the canal from its opening in March, 1892, he estimated that 329 million cubic feet of silt must have passed into the canal in the ten years ending March, 1902, yet during that time, so far as he was aware, no silt clearance had ever been made from the main or branch channels. The bulk of the silt had been carried right through the system and deposited on the fields—"Proc." Inst. C.E., Vol. CLIII., page 144 *et seq.*

In the Panjab Triple Canal Project Sir John Benton states that Mr. Kennedy's hydraulic diagrams were used, giving critical velocities below which silting would be liable to occur with sand of the grade found in the Panjab. The main canals were designed with a uniform gradient of 1 in 6666—0·15 per thousand—and the distributaries with a gradient of 1 in 5000—0·2 per thousand—"Proc." Inst. C.E., Vol. CCIV., Plates 2 and 4.

Minor defects in Mr. Kennedy's formula for critical velocities have been noticed, but the general evidence goes to show that these velocities kept the canals clear of the silt brought down by the rivers of the Panjab. Mr. Kennedy's equation therefore defines the gradient of a canal in which, for any depth the velocity will be such as to sweep along the canal bed sand brought in from the parent river. For the grade of sand found in the Panjab Rivers this velocity is given by the equation

$$V = 0 \cdot 84\, D^{0 \cdot 64}$$

where D is the depth and V the mean velocity of the cross section of the canal under consideration.

In Manning's formula, if n is taken equal to 0·0225, and approximately D the depth as the hydraulic mean radius

$$V = 66\, D^{\frac{2}{3}}\, S^{\frac{1}{2}}$$

Also approximately

$$V = 0 \cdot 84\, D^{\frac{1}{2}}$$

$\therefore$ S = 0·16 per thousand very nearly.

In the Roorki Treatise on Civil Engineering, Vol. II., Colonel Anderson states that in alluvial country he preferred for canals a constant slope of 6in. a mile and depths from 10ft. to 6ft. Mr. Marsh—"Proc." Inst. C.E., Vol. CCI., page 52—states that the Agra Canal, constructed, after the experience gained in the Gangee Canal, with a gradient of $^1/_{10560}$—about 6in. a mile—gave very satisfactory results. Elsewhere—Irrigation Conference—Mr. Marsh has stated that he preferred a uniform gradient of 6in. a mile for canals in the United Provinces. Sir John Benton pointed out that Mr. Marsh had been very successful with the flat slopes used by him in the works of the United Provinces. The Panjab rivers, however, carried more silt and of a coarser grade than was carried by the rivers of the United Provinces—"Proc." Inst. C.E., Vol. CCI., page 60.

In dealing generally with the equation

$$V_e = C\, D^x$$

where V_e is the mean velocity in a canal necessary to sweep along the canal bed the silt entering it from the parent river, the exponent of D for practical purposes may be taken as $\frac{2}{3}$, and the coefficient C as an index of the amount and grade of silt entering a canal from the parent stream. Assuming as before Manning's formula,

$$V = 66\, D^{\frac{2}{3}}\, S^{\frac{1}{2}}$$

the necessary slope or gradient of a canal for a critical velocity V_e is given by the formula

$$66\, S^{\frac{1}{2}} = C\ (C\, D^{\frac{1}{3}} = 66\, D^{\frac{2}{3}}\, S^{\frac{1}{2}})$$

C is obtained by observation of canals in a system which do sweep along the silt entering from the parent river.

In the case of the United Provinces $S = \frac{1}{10{,}000}$

Therefore approximately C = 0·66 and the formula for the United Provinces becomes

$$V_e = 0 \cdot 66\, D^{\frac{2}{3}}$$

In the Godavery Western Delta Canal system, Madras Presidency, the critical velocity was found to be 0·7 of Kennedy's V_o. Therefore, for the Godavery Western Delta Canal system

$$V_e = 0 \cdot 588\, D^{\frac{2}{3}} = 66\, D^{\frac{2}{3}}\, S^{\frac{1}{2}}$$

$\therefore$ S = 0·079 per thousand, which agrees very nearly with Table VII., page 318, "Proc." Inst. C.E., Vol. CCXXIX.

It is a mistake to call it "Madras data," as the conditions obtaining in the Godavery Western Delta canal system are peculiar, in that no sand from the Godavery River enters the system, owing to there being deep water in the river in front of the head sluice to the system. In most other Madras irrigation systems sands of a considerably coarser grain than the sands of the rivers of North India are found—see also THE ENGINEER, August 29th, 1930, page 219.

In the case of Egyptian canals, the Ibrahimia Canal (Assiout), with a depth of 29·53ft. and a mean velocity of 4·51ft. per second, is stated to be in regime—"Proc." Inst. C.E., Vol. CCXXIII., page 286.

Here
$$V_e = C\, D^{\frac{2}{3}}$$
$$4 \cdot 51 = C \times (29 \cdot 53)^{\frac{2}{3}}$$
$$C = 0 \cdot 472$$

And the formula for Egyptian canals becomes

$$V_e = 0 \cdot 472\, D^{\frac{2}{3}}$$

This makes S = 0·051 per 1000, which very nearly agrees with Table XI., page 350, "Proc." Inst. C.E., Vol. CCXXIX.

Taking the case of the Kasra Canal, page 280, "Proc." Inst. C.E., Vol. CCXXIII.

D = 15·6ft.

$V_e = 0 \cdot 472 \times (15 \cdot 6)^{\frac{2}{3}} = 2 \cdot 947$ft. per second
$= 0 \cdot 9$ m. per second.

In the above approximate calculations Manning's formula is used, as it is the most convenient and adaptable for rapid work, although values of n have been observed to be as low as 0·02 and 0·018 in canals that have been luted with clayey material, and which have moderate gradients. Numerous observations have shown that the value $n = 0 \cdot 0225$ is most common.

There is another aspect to be considered where a canal, channel, or natural stream erodes or accretes in the medium or soil in which it flows. This is quite a different concept from conditions obtaining in what may be called a "Kennedy Channel." There the velocity for a given depth is such as will sweep along the bottom sand entering it from the parent river.

The case now being considered is analogous to that of a canal or channel beyond the influence of any sand entering it from an outside source. The conditions are (*a*) where owing to the volume of water passing down a channel with a velocity greater than the soil in which the channel is excavated can stand, the original section of the channel is increased, or, on the other hand, (*b*) if the velocity is so low as to cause alluvial matter, held in suspension, to be deposited on the

bed and slopes, the section of the canal is reduced by accretion—*vide* Fig. 6.

Mr. Seddon has shown that in channels flowing in sand, where they are permitted to erode their sand beds until no sand is carried forward, the channels become broader and shallower as the slope increases, the mean velocity remaining constant for all slopes.

Assuming Manning's formula as before,

$$V = C R^{\frac{1}{2}} S^{\frac{1}{2}}$$

V in this case is constant and the flatter the slope the greater will be the hydraulic mean radius or mean depth. That is, if the soil through which a channel or stream runs is similar in character for the whole of its length, and the volume passing down is continually being augmented, if the velocity be constant for the whole length of the stream the mean depth will increase and the slope get flatter. On the contrary, should the volume decrease the mean depth will decrease and the slope become steeper. The first case is analogous to that of a natural stream or river from its source to its mouth; and the latter to a canal and is distributaries, flowing in and eroding its natural soil.

In a natural stream or river the soil through which it flows varies from its source to its mouth, and consequently, in applying Manning's formula for the purpose of comparison, the coefficient *n* will vary.

Take the case of the Jumna River, which is practically a continuation of the Ganges. In the flood of 1924, it is stated in the "Proc." Inst. C.E., Vol. CCXXIII., page 252, that the Jumna at Kalsi had a mean depth of 5·8ft. and a bed slope of 1/140, the bed being composed of shingle and boulders, *n* being considered as equal to 0·035. With this value of *n* Manning's formula gives the mean velocity as 11·6ft. per second. Lower down, at Faizabad, in the normal section of the river, the mean depth was 9·7ft. and the bed slope 1/300. The bed here also consisted of shingle and boulders. Assuming the same value of *n*, the mean velocity is about 11·1ft. per second.

On page 291 of the "Proc." Inst. C.E., quoted above, the surface velocity of the Lower Ganges at Sara in the same flood of 1924 is given as 9·18 miles per hour, or 13·46ft. per second. The Indus River Commission gives as an average the mean velocity as 0·85 of the surface velocity. Assuming this value the mean velocity will be about 11·5ft. per second. In Vol. CCV. the surface slope of the river when in flood is stated to be 0·36ft. per mile—page 26—and the soil to consist of fine micaceous sand, extending to unknown depths—page 22. With such a river in flood, *n* in Manning's formula will not greatly differ from 0·0225.

Assuming this value with a slope of 0·36ft. per mile, or 1/14,616, and a mean velocity of 11·5ft. per second, the formula

$$v = 66 R^{\frac{1}{2}} S^{\frac{1}{2}}$$

makes R or approximately the depth in this flood as 96ft. On page 291 of "Proc." Inst. C.E., Vol. CCXXIII., it is stated that records showed a depth of 95ft. between piers of the Sara Bridge in the flood of 1924. The figures given above may be merely a coincidence, but agreement with the theory is remarkable.

There is still Mr. Kennedy's theory to be considered in the case of the deltaic reach of a river. As its delta advances seawards the bed of a river must naturally rise. This is compensated for, as explained in the opening paragraph of this article, by the river in flood spilling its margins, depositing the alluvial matter held in suspension, and thus embanking itself. If, however, the river is leveed, the external spills are prevented, and in consequence the depth in flood must increase. If the tidal reach is of such a width that owing to the increase in depth the surface gradient is flattened, the velocity may be insufficient to sweep the sand, forming the bed of most Indian rivers, along, thus causing the bed to rise—*vide* "Proc." Inst. C.E., Vol. CCXVI., pages 155, 156.

Institution of Naval Architects.

No. I.

SUMMER MEETING IN PARIS.

THE Summer Meeting of the Institution of Naval Architects, which opened on Monday evening last, June 29th, in Paris, and will be continued until to-morrow—Saturday—at Saint Nazaire, has been arranged jointly with the Association Technique Maritime et Aeronautique, and marks an interesting event in the annals of the Institution. The present meeting is the third to be held in France, others having taken place in Paris in 1895 and 1922, when the papers were read at the Sorbonne.

The British party includes no less than 200 members, guests, and their ladies, and the main party travelled on Monday last by the Folkestone-Boulogne route, a fast and smooth crossing being made by the Denny-built steamer the "Isle of Thanet." On arrival in Paris the party was joined by the President, Lord Wester Wemyss, who on the preceding day had taken part in the ceremony of the unveiling of an equestrian statue of Field-Marshal Earl Haig, by Monsieur Maginot, the French Minister of War, at the Grande Place, Montreuil.

The welcome to the British party took place at an informal reception held at Hotel Georges V., on Monday evening, when the members were officially received by Monsieur Emmanuel Rousseau, the president of the French Institution, and Monsieur Georges Bourges, the secretary. A short welcoming speech was given by Monsieur Rousseau, to which Lord Wester Wemyss replied in suitable terms, after which music and dancing took place.

The first session for the reading of technical papers took place at the Salle d'Iena, once a private mansion of the Prince Roland Bonaparte, but now the property of the Suez Canal Company. It was attended by a large number of the members of the Association Technique Maritime et Aeronautique, and an official welcome was extended to English visitors by the French Minister of Marine, Monsieur Charles Dumont.

Monsieur Dumont recalled that the Institution of Naval Architects was formed sixty-six years ago on the initiative of John Scott Russell, and had been followed by the establishment of the French Association, which had since embraced aeronautics with naval architecture. The Institution of Naval Architects, however, had a membership of 3000, and was composed of naval architects, electrical engineers, and mechanical engineers; in other words, it covered the whole domain of naval architecture—technical, commercial, and military. The numerous papers published by the members of the British Institution of Naval Architects had aided progress in a remarkable manner, and it was pleasing to note that the interchange of views between British and French constructors at these congresses was of the greatest possible advantage, as, indeed, was the case with conferences between French naval architects and their American, Japanese, and Italian colleagues, because in that way the naval architects of the world were enabled to envisage the many different problems from the same angle. That, indeed, should be the one aim of these conferences. The naval architect, beyond being a technical man and an engineer, ought to be an inventor, a creator, an inspirer, and at the same time an artist, for art was essentially a realisation of harmony. It was institutions such as the Institution of Naval Architects and the French Association which helped the architect to arrive at the full realisation of his conceptions and hopes. In the name of the Government of the Republic and the French nation, he expressed the hope that there would be peace with security and work, and he extended a hearty welcome to the Institution at its Summer Meeting in Paris.

After the Minister of Marine had concluded his speech, Monsieur Emmanuel Rousseau expressed to him the thanks of the French and English Institutions for the honour he had shown them in being present at the opening meeting and mentioned the eminent services of the Minister to the State, both in his present and previous offices.

Speaking specially in regard to the Institution of Naval Architects, Monsieur Rousseau expressed the deep privilege he felt in welcoming its members. The Association Technique Maritime et Aeronautique recognised a debt to the British Institution on which it had, to some extent, been modelled. Many of its members belonged to both Institutions. An effective *liaison* had been maintained between the two bodies by the valuable work done by Mr. R. W. Dana, and he personally recalled the meetings which were held in 1924 in London, Glasgow and Newcastle, when, under the presidency of the late Duke of Northumberland, members of the French Association had been the guests of the Institution.

With regard to Admiral of the Fleet Lord Wester Wemyss, the President, it was true to say that he was regarded with the same honoured esteem, in France as in England.

Lord Wester Wemyss (President of the Institution of Naval Architects), acknowledging the welcome accorded to the Institution, said that since the last meeting of the Institution in Paris in 1922 much water had flowed under the bridges, both of the Seine and the Thames, but much more important things than the flow of water had taken place during that period. It was not too much to say that the past nine months had witnessed a great change in world conditions—a change which had profoundly affected the industrial outlook of nearly all the nations, and in no industry had that change been more pronounced than in the shipbuilding industry. In 1920–21 the merchant shipping under construction had reached its peak in Great Britain with a tonnage of 3¾ millions; to-day that figure had fallen to less than 1 million tons. Concurrently with this unprecedented decline in merchant shipping, there had been an almost equally sensational falling off in warship construction. This latter reduction in armaments was due to a sincere desire on the part of all the leading nations to endeavour to avoid, not only war, but the causes of war, and the race in armaments which formerly took place was held to be one of the main causes of possible strife between nations. But while all were loyally endeavouring to remove the possibility of armed conflicts, it must be admitted that for the shipbuilding industry it was indeed most unfortunate that the great trade depression which had spread like a dark cloud all over the world had coincided with the period of naval treaties which had severely limited the construction of new warships, whilst scrapping many of those already in existence. On that occasion he would do no more than express the fervent hope that what had already been done towards ensuring the future peace of the world would bear fruit and not lead the world into an *impasse* out of which it might be difficult either to go forward or back.

The mercantile shipping problem, although equally serious, was, perhaps, easier of solution, for the cycles of good trade and bad trade, of lean years and fat years, had, from time immemorial, confronted industrial and trading communities. But the inexorable laws of supply and demand eventually tended to restore the balance of trade by eliminating the weaker branches of industry, by cutting out that which was redundant or unnecessary, and by improving methods of production and distribution, and thus restoring prosperity to those nations whose methods of government, both national and municipal, were based on sound principles, and whose citizens used their intelligence and energy to build up their national industries with all the resources at their command. People in England had always admired those traits which had made France the great country she was, and in the domain of naval architecture had always held in high esteem the methods by which French constructors evolved that branch of engineering on scientific lines long before it was recognised as a science on our side of the Channel. True, British shipbuilders, by their practical common sense and long experience, tried out by many years of trading and fighting at sea, managed to turn out wonderfully good and seaworthy ships, but the French ships of the seventeenth and eighteenth centuries were often better than ours, and it was from that rivalry that sprang our desire to improve our methods of shipbuilding and to found colleges where the art of naval construction could be properly taught on scientific lines. On the other hand, the Institution of Naval Architects, which was founded in 1860, preceded the French Institution by some 26 years, and when, in 1886, the Association Technique Maritime was established, it followed upon very similar lines to those which governed the British Institution, and which had been found to work satisfactorily in practice.

The first meeting which the British institution held abroad was the 1895 summer meeting in Paris, held under the presidency of the late Lord Brassey, who was a firm friend and admirer of the French people, and whose father had in 1840 built the first French railway, from Paris to Rouen. Monsieur Bertin, who for so many years presided over the meetings of the Association Technique Maritime, welcomed the members of the British institution on that occasion, and again twenty-seven years later he was the principal host of the British institution when a similar meeting was held in Paris and Havre, during the Duke of Northumberland's tenure of office as President of the Institution. On each occasion the visits were marked by the utmost cordiality, and the excellent papers that were read and discussed added greatly to the value of bringing together so many distinguished naval architects, engineers and constructors from both sides of the Channel. He had no doubt that the present meetings would prove of real value to the advancement of naval architecture. The French Association since the last meeting in France had made rapid strides; the membership had increased threefold during the past nine years, and the value of the published papers and "Transactions" had immensely increased both in scope, volume and standard of excellence. Under the long reign of that past-master of naval architecture, Monsieur Bertin, the Association enjoyed great distinction, and the prestige of its high scientific attainments was increased, but under the wise governance of the late Monsieur Doyère, that very distinguished head of the French Naval Construction Department, and with the energetic work of their admirable secretary, Monsieur Bourges, the Association had entered upon a new era in its history. To-day, Monsieur Rousseau was the distinguished occupant of the presidential chair, and they could not have chosen a better President. Recognising the special qualifications of Monsieur Rousseau, the Institution desired to pay him the compliment of conferring upon him the highest distinction it was within its power to bestow, viz., the hon. membership of the Institution, and the President said he had great pleasure in offering Monsieur Rousseau the diploma of that membership, with the assurance that he was not only welcomed as a most distinguished colleague, but that his name was added to the roll of honour as one of the most valued members of the Institution.

In accepting the diploma of honorary membership, Monsieur Rousseau expressed his thanks to the Institution for the signal honour conferred upon him, which was one which, he felt, would be shared by the Association of which he was for the time being the temporary head.

The Secretary then announced the names of the candidates recommended for election and they were duly elected.

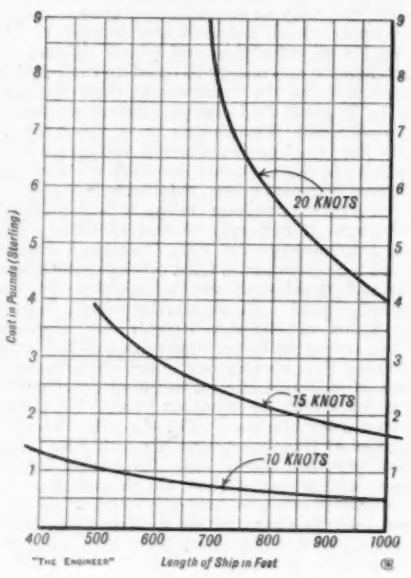
The President referred with regret to the fact that Sir John Biles, the reader of the first paper, was unable to come over, and he asked Mr. Dana, the Secretary, to present it.

DRAUGHT AND DIMENSIONS OF THE MOST ECONOMICAL SHIP.

In his paper, Sir John Biles referred to the investigations which were made in 1913 into the

relation between the cost of transportation of goods by sea and the draught of ships carrying such goods. These results, he said, were presented to the Dominions Royal Commission in 1913 and 1914. The problem was again dealt with at the Thirteenth International Congress of Navigation held in London in 1923. As a result of further investigations he was now of the opinion that it would be economically desirable in future, so far as the ship was concerned, to carry merchandise in ships with a draught of 60ft.

In discussing the results of the investigation with the aid of curves and figures given in the paper, Sir John first dealt with the effect of the first cost of the



propelling machinery and the influence of the frictional resistance of the wetted form and the wave resistance. The total horse-power was the sum of the frictional and wave horse-power. These experiments could be, he said, translated into machinery and fuel costs required to drive a ton of weight of ship and load through the water at any speed in any length of ship. This had been done in the diagram above, which gave the total engine-room cost per ton of displacement at three speeds, 10, 15, and 20 knots, for lengths of ship from 400ft. to 1000ft. It would be seen that it was almost as cheap to drive 1 ton at 15 knots in a 1000ft. ship as it was to drive it at 10 knots in a 400ft. ship. It was also as cheap to drive a ton at 20 knots in a 1000ft. ship as at 15 knots in a 500ft. ship. From these results it was clearly apparent that from considerations of horse-power alone the big ship was always more economical than the small ship, and the higher the speed the greater the economy. Various other factors which are related to the increase of size and modified the result, such as weight of hull, size of scantlings and cargo handling, were then discussed, the conclusions being set down in the following summary.

It was shown in the paper and in the Dominions Royal Commission Report :—

(1) That up to a limit of length of ship the cost of transportation decreases with increase of length if breadth and draught be increased in the same proportion.

(2) That if draught be not increased with increase of length the cost of transportation steadily increases.

(3) That the limit of length up to which transportation costs decrease with increase of length is greater the greater the speed and the longer the voyage.

(4) The Dominions Royal Commission in their Report (1917) considered 38ft. draught of ship as obtainable on many routes, but did not think it desirable to extend their inquiry to greater draught, as it did not appear to be possible for the present to obtain greater draughts on the principal Imperial routes.

(5) Draughts of ships have steadily increased from 16ft. a hundred years ago to 32ft. to-day through the Suez Canal ; 34ft. round the Cape and 40ft. on the North Atlantic trade.

(6) Improvements in hull structure and economies in weight of machinery and consumption of fuel help further to increase the length of ship having minimum transportation cost.

(7) Large ships of high speed may do a service of cargo delivery on less capital than slower ships.

(8) The modifications already known to be practicable in hull and machinery, as given in the tables, showed the length of ship having minimum transportation cost at 14 knots to be somewhere round about 800ft., and at least 10 per cent. better than at 600ft. length. At 17 knots it was 900ft., and was at least 30 per cent. better than the 600ft. length. At 20 knots the 1000ft. length was much better than anything shorter, and was probably only half of that of the 600ft. length.

(9) The draughts corresponding to 800ft., 900ft., and 1000ft. lengths were 46ft., 52ft., and 59·6ft. respectively.

Full consideration led to the conclusion that, with possible rates of cargo handling much in excess of those in practice to-day, 60ft. draught of water was the draught corresponding to the minimum cost of transportation.

Engineer Rear-Admiral Roland Boris, G.C.M.G., of the French Navy, opening the discussion, expressed regret that he was not able personally to congratulate Sir John Biles on his paper. Sir John had been closely associated with the solution of many important naval problems, and he hoped that he might long continue his many-sided scientific activities.

In the half-yearly bulletin, published in July, 1927, by the Permanent International Association for Navigation in Brussels, a report prepared by a special committee appointed by the French Government would be found. Since that date it appeared that no particular research on the subject dealt with by Sir John Biles in his paper had been made. Further, there was no mention of it in the agenda of the fifteenth International Congress, which is to take place in Italy in September next. In the 1927 report of the French Committee, however, several conclusions dealing with the limitations of large ships were reached. They covered :—The question of stresses in structural material ; the difficulty of handling very large ships ; the question of the accumulation of capital expended ; the cost of sheds ; the bending moments of the hull with relation to wave lengths. The latter section was again affected by the continued improvements made in the tensile strength of materials. He noted the decrease in the stress ratio given in column *f* in Table I. of the paper, after a length of 900ft. had been reached. That he found somewhat peculiar. With regard to that section which dealt with propelling machinery and of the costs of transporting 1 ton of cargo, the same subject would be treated in the paper by Messrs. Wall and Carey, when he hoped some additional information would be given.

Monsieur Max Bahon, K.B.E., Director-General of the Suez Canal, said he found the paper particularly interesting, as it dealt with the subject both from the technical and economical aspects. Sir John had sought to determine suitable dimensions for a ship which would give a maximum commercial return, and unhappily the conclusions which he reached would fix the draught of such a ship deeper than before, varying, say, from 40ft. to 60ft. He expressed doubt whether the canals of the world would for a long time be able to accommodate such extraordinary ships. As regarded the Suez Canal in particular, the maximum draught permitted was 33ft. It was interesting to predict that within a little time, say, from two to three years, draughts would reach 35ft., as the depth of the Canal was 42ft. The company was obliged to retain a margin of at least 6ft. in order to take into account the silting up which might be caused by the passage of large ships through the Canal. The policy of the company was, always to maintain the Canal in such a state that any ship engaged in the Far Eastern trade would not find itself prevented from using the Suez Canal route.

Sir Eustace T. d'Eyncourt said the author seemed rather to have omitted the third dimension, viz., beam. In considering these very large ships which he proposed, he suggested that the most economical ship would be one which was increased proportionately in beam to a smaller ship which had been found to be economical. On that basis, if we took a ship 1000ft. long by 60ft. draught, as suggested in the paper, as an economic ship for the future, the beam would be something like 140ft., and such a ship would have a displacement of 140,000 or 150,000 tons. A lot of water would have to flow under the bridges before we had a ship of that size, because it would be very difficult to handle the cargoes and to find ports at which such a ship could be accommodated. The test of an economic ship was the expense involved in providing dock and harbour accommodation and at the present moment the consideration of such ships was rather academic. Another economic question was the insurance of such vessels.

Mr. J. Foster King expressed surprise that Sir John Biles had used in his analysis the obsolete formula displacement, by length, over weight. Naval architects believed that fine ships would suffer less than full ships in bad weather, and that eliminated the factor of coefficients of fineness and had done so in merchant practice during the whole of his career. As the matter now stood, he was prepared to go farther than he did in his 1928 paper, and would say that in practice the draught used with the dynamic factor then referred to should not be less than 5 per cent. of the ship's length, even in the case of a passenger ship in which the loads were under control and did not vary violently about the centres of the points of support. In the case of cargo ships of the sizes being discussed by the author, it was quite probable that the factor should not be less than 6 per cent. of the length. It was rather unfortunate that the original so-called calculations of wave crest effects should have been based on waves of the whole length of the ship because of the psychological effect that had on those who used the calculation and who were taught in the schools. In his own paper he had pointed out that the effect of two waves in the static condition might be as big as that of one wave, and he believed that all who had been at sea would agree with him that the seas which caused the trouble and ultimate failure in particular cases were not waves of the ship's length, but waves remarkably small in proportion to the dimensions of the ship. Therefore he strongly deprecated the suggestion in the paper that if a 1200ft. ship was built it might have a deck as strong as a 600ft. ship. The analysis of the stress effects in the "Leviathan" by Mr. Wilson in America bore that out.

Mr. Francis Henderson, speaking as one who had been a member of the Mersey Docks and Harbour Board and of the Clyde Navigation Trust, said the question of providing deep-water dock and harbour accommodation for such large vessels as those mentioned in the paper was of paramount importance. The provision of accommodation for larger and larger vessels by the Mersey Docks and Harbour Board had involved great expense in deepening the docks, and then still further expense when the deepening got below the walls of the docks, which had to be strengthened. It was then thought that water might be pumped into the docks to provide accommodation, but it was discovered that the larger ships then towered so much above the sheds that unloading was impossible. But when the docks were deepened to obviate this difficulty it was found that the walls were affected through the foundations being weakened. Millions of money would therefore have to be spent in providing accommodation for vessels of the size mentioned in the paper. Without that expenditure such vessels could not be accommodated at any of our present ports, and what was the use of large vessels which could not come into any port.

Professor J. R. Jack, speaking on the question of the impossibility of finding dock accommodation for very large vessels, suggested the use of train ferries for unloading such ships in deep water, similar to those which could be seen crossing New York harbour. Those ferries could carry railway trains and lorries which could be loaded direct from the large ship in deep water. At the same time, such large ships would involve the consideration of many problems which had not yet been adequately gone into. The question of strength was in itself a very big thing. The pressure on the shell and the bottom was very important, and must be provided for either by thickening the bottom plating or increasing the support. If the plating was thickened it would bring down the neutral axis and disturb the distribution of stress, making it very much larger on the top and smaller on the bottom than was desirable. That suggested a very close frame spacing in the bottom, say, 2ft. or 2ft. 6in., with every alternate frame omitted, above the water. The troubles with the "Leviathan" and the "Majestic" were not due to whole structural weakness, but to local defects in design. Part of the deck plating between the two upper decks was not adequately supported, because it was not practicable to do so. The danger was that the structural strength of a vessel such as suggested in the paper would be considerably reduced as compared with a ship 600ft. long. Another effect of dealing with such large cargoes as would be dealt with in such large vessels was the effect upon lowering prices through the quantity brought over at one time.

Sir John Thornycroft, commenting on the remarks of Mr. Francis Henderson and the cost of providing dock accommodation for very large vessels, pointed out that the Harbour Authorities at Southampton had thought it an economic thing to provide, not only ordinary docking accommodation for the largest vessels, but also dry dock accommodation, which at first sight would have been thought the responsibility of the shipowner. Many millions had been spent in that way at Southampton. Nothing short of a Washington Conference would limit the size of vessels.

Mr. H. G. Williams said that what determined the relative economy of the large and small ship was the load factor, *i.e.*, the fraction of the complete capacity that was in use continuously. At the present time shipowners were finding it difficult to obtain cargoes for 5000-ton ships, although that was not the case in more prosperous times. At the same time, for cargoes of 50,000 or 100,000 tons he felt it would be a very difficult thing under any conceivable circumstances to obtain a load factor which would make the ship economical.

The President, expressing the thanks of the meeting to Sir John Biles, said that had he been present he would no doubt have put up a very good answer to the various criticisms that had been made.

(To be continued.)

A NEW hydrographic survey steamer, for use by the Canadian Government marine surveyors in the Pacific Coast service, is to be constructed and equipped by the Collingwood Shipyards, Ltd., Ontario. The vessel is to be fitted with the most modern equipment for marine survey work, and elaborate accommodation will be provided for the hydrographers and their assistants, as well as for the ordinary crew. The contract price, which is slightly in excess of 600,000 dollars, includes both vessel and equipment. The ship is to be 214ft. long between perpendiculars, with a moulded breadth of 36ft. and a moulded depth of 23ft. 6in. Provided with two triple-expansion engines and two boilers, the vessel is designed for a speed of 12 knots.

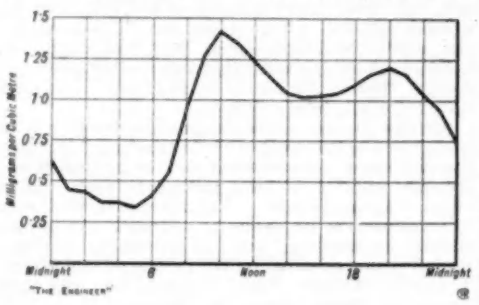
The Royal Air Force Display.

LAST Saturday's Display at Hendon fully maintained the standard set by the eleven similar events which preceded it. The public showed no sign of diminishing interest in the work and capabilities of the Air Force. Indeed, it was evident that it has now, thanks very largely to the annual display, acquired a critical judgment in these matters. The display forms part of the Air Force's annual training, and is so regarded by the authorities. It affords an opportunity for handling large numbers of aircraft, and for arranging the necessary ground organisation on a scale which is outside every-day experience, and from that point of view is of great value to the Air Force as a whole. Incidentally, it results in a handsome annual contribution to certain deserving Air Force charities. Nearly 200 machines took part in last Saturday's display. These were of all types, from "Moths" and "Avros" to Hawker "Furies" and the very latest four-engined Vickers night bomber. The three-seater "Pterodactyl," which we illustrated last week, flew in company with the "Autogiro" and the Handley Page "Gugnunc" safety-first machine. A reproduction of the machine on which Blériot flew the Channel in 1909 was taken into the air simultaneously with some of our latest interceptor fighters and other equally modern products. The contrast was noticeable, not only as regarded speed, but in so far as it recalled forcibly the barbarous system of wing warping which preceded the introduction of ailerons as a means of lateral control. Demonstrations of re-fuelling in the air and of the launching of a Vickers "Virginia" night bomber by catapult were also included. Perhaps the most impressive event was a converging bombing attack by six Fairey "Flycatchers" on a small encampment. A low-flying aircraft presents a fairly easy target to ground troops when it is flying away from them after having delivered its attack. The converging attack is carried out by a number of machines which swoop down from different points on a circle round the target, and depart in various directions. The effect would appear to be annihilating.

An Instrument for Measuring the Degree of Smoke Pollution of City Air.

AN instrument has been in use for some years for the investigation of atmospheric pollution, in which measured volumes of air are automatically filtered through white paper, leaving behind a discoloration, the intensity of which is a measure of the degree of pollution. Two instruments of this type have been in use. One of these takes a single record by allowing water to run from one bottle into another, thereby aspirating a measured volume of air through the filter paper. The other is an automatic instrument, also water operated, and gives records of an exactly similar type to the single record instrument. In both of these, 2 litres of air are aspirated through a spot on the paper ½in. in diameter.

By the use of such instruments, it has been possible to obtain a quantitative measure of the degree of smoke

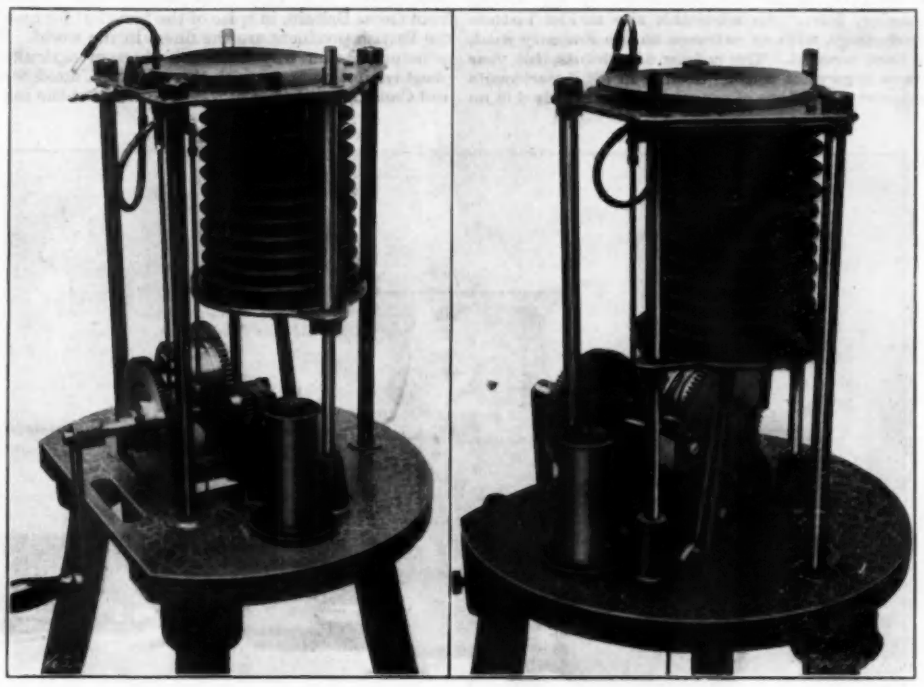


LONDON AIR POLLUTION

pollution in city air and of its variation from hour to hour. This variation has been found to be remarkably similar for all cities, and a typical chart for London is given above. It is usual in such records to find comparatively pure air from midnight until early morning, when a rapid rise of impurity to a peak in the forenoon takes place, followed by a somewhat irregular fall to a second maximum in the evening, after which there is usually a regular fall until about midnight. These two maxima are very constant in different cities, but the hour at which they occur varies. It has been found, for example, that the forenoon maximum on Sundays is usually about an hour later than on week-days.

The necessity for an instrument capable of operating without a water supply and in which the sensitiveness could be varied by varying the volume, became apparent, and the accompanying illustrations show the form which such an instrument has taken. Briefly, it consists of a train of gearing operated by a weight, somewhat on the lines of a clock, but having instead of an escapement to regulate the rate of operation, a bellows which is operated by means of a crank. On the upstroke of the bellows the air inside is exhausted through a small opening, and on the downstroke this opening is closed by the filter paper. Thus in both the up and down strokes, the rate of movement of the bellows is governed by the rate at which air can be discharged or drawn in. This control is found to give very regular operation. The use of a weight as a source of energy makes the instrument independent of any outside source, and therefore it can be placed in any convenient position.

In one downstroke of the bellows, 1 litre of air is aspirated through the paper, and on the upstroke the paper is automatically released, the air blown out and a circular disc of filter paper, 7in. in diameter, on the edge of which



OWEN'S SMOKE POLLUTION METER—MECHANISM

the records are taken, is caused to rotate through a small angle. On the downstroke of the bellows, the filtering nozzle is pressed against the paper by a spring, so that the air is forced to pass through the paper. In order to vary the volume filtered, an arrangement is embodied in the instrument which causes the filter paper to remain in one position over the entrance to the bellows for either one,

COMPLETE INSTRUMENT

two, four, or eight strokes of the bellows. The number of strokes allowed before the paper is moved is governed by a sliding cam with projections which engage a cam rod, the lifting of which causes the disc to revolve. This sliding cam can be set in four positions along the shaft, causing the paper to remain fixed for one, two, four, or eight strokes.

The speed ratio of the crank to the drum upon which the wire suspending the weight is wound is 24 : 1, and the weight is about 100 lb. The regulation comes about since the weight operating the gearing falls a definite distance for each stroke, the energy input per stroke therefore being constant. At the other end, the bellows aspirates or discharges a fixed volume of air through a definite sized orifice. Thus the work done here is also practically constant.

The standard instrument is arranged to work for a period of about thirty hours, so that it requires winding once a day. The filtering disc, when the instrument is set to filter 1 litre per record, will take one day's records, while when it is set to filter 8 litres per record, it will last for a week. When inserting the record disc, the time of starting is noted on the disc and the time of finishing when it is removed. The records are distributed uniformly over the period between.

It is anticipated that the possibility of varying the sensitiveness of the instrument will give it a much wider field of use than that of the existing water-operated filter, which has a fixed volume of 2 litres—the most suitable quantity for a large city. When this 2-litre instrument is operated in clean country air, the records are not sufficiently marked for easy reading.

The method of reading the records obtained from the new instrument is the same as that already in use. A scale of shades, numbered from 1 to 20 in the order of the amount of black on the shade, is compared with the record by viewing the latter through a small hole in the centre of the shade. This scale, therefore, indicates the quantitative impurity directly. Shade No. 2 has double the impurity of shade No. 1, and so on. Thus, when the value of the unit shade is known, quantitative values can be given to the records. The value of the unit has been ascertained by direct weighing from a sufficiently large filter disc to give a weighable quantity, and, for London, this has been found to be 0·32 of a milligramme per cubic metre of black impurity. Doubtless, it varies in different places to some extent, but so long as the estimation is limited to black or sooty matter, it gives a fair measurement of the concentration.

Although the instrument is primarily designed for measuring sooty impurity, it can be applied to dusts of other colours by using filter paper of a suitable colour. It was invented by Dr. J. S. Owen, the Superintendent of the Advisory Committee to the Meteorological Office on Atmospheric Pollution, and it is made by C. F. Casella and Co., Ltd., of Fitzroy-square, London.

BOOKS RECEIVED.

Electric Motor Management. By A. H. Avery, A.M.I.E.E. London: Percival Marshall and Co., Ltd., 66, Farringdon-street, E.C. 4. Price 3s. 6d. net.

The Macmillan Table Slide Rule. By J. P. Ballantine, Ph.D. London: Macmillan and Co., Ltd., St. Martin's-street, W.C. 2. Price 2s. 3d. net.

Mineralogy. Sixth edition. By F. H. Hatch, O.B.E., Ph.D. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 6s. net.

Report of the Food Investigation Board for the Year 1930. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

The Manufacturing Industries of the British Empire Overseas. Part IV.: New Zealand. London: Erlangers, Ltd., 4, Moorgate, E.C. 2. Price 2s. 6d. net.

Charts and Data on Marine Boiler Design. By H. C. Walker, M. Inst. N.A. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 25s. net.

The Creep of Metals. By H. J. Tapsell, A.C.G.I., A.M.I. Mech. E. London: Oxford University Press, Amen House, Warwick-square, E.C. 4. Price 30s. net.

The Royal Agricultural Show at Warwick.

No. I.

THE Royal Agricultural Society's ninetieth annual Show will be held this year at Warwick from July 7th to 11th, under the presidency of Sir Arthur Hazlerigg, Bart. An admirable site amidst historic surroundings, with an entrance on the Banbury road, has been secured. The entries of exhibits this year show a somewhat serious decline in all departments compared with those of recent years, which is due no doubt to the general depression in both the agricultural and engineering industries. The implement section is the chief sufferer from this cause. The last time that the Royal Show was held at Warwick was in 1892, when the implement section comprised 408 stands and required over 13,000ft. of shedding, whereas this year the stands number only 388, and require only 8963ft. of shedding. This will, in fact, be the smallest exhibition of implements which the Society has got together for many years. The live-stock, poultry and produce section of the Show will, however, compare more favourably with those in the past, the number of horses, cattle, goats, sheep, and pigs being 3061, which is only slightly fewer than the entries last year at Manchester.

Beyond the usual awards of silver medals for new implements, there will be no other competitions in the machinery section at Warwick, but those interested in the development of agricultural tractors will have an opportunity of inspecting and comparing many of the machines which took part in the series of successful trials which were held near Wantage last autumn, in conjunction with the Institute of Agricultural Engineering of Oxford, a full report of which appeared in THE ENGINEER of September 19th and 26th last. There will, however, be a newcomer in the traction section which will create some interest, namely, the new American four-wheel driven general purpose petrol tractor exhibited by the Massey-Harris Company, Limited, of Bunhill-row, London, to which further reference will be made later.

There are only eight competitors for the silver medals:—A sprayer for agricultural purposes, by Aktieselskabet Kartof, of Copenhagen; a horse-drawn mowing machine with forced feed lubrication of the revolving parts, by Harrison, McGregor and Co., Ltd., of Leigh, Lancs.; a crude oil tractor, by Richard Garrett and Sons, of Leiston; a mower with oil bath lubrication, by Bamfords, Ltd., of Uttoxeter; a harvester thrasher, by Clayton and Shuttleworth, Ltd., of Lincoln; a milk cooling plant, by Wessex Refrigerating Plants, Ltd., of Wells, Somerset; a portable electrically-operated haulage drum, by the General Electric Company, Ltd., of Kingsway, London, W.C. 2; and a milking machine, by Gascoigne's (Reading), Ltd.

It is by means of exhibitions such as the Royal Show that the general public can form some idea of the extent and importance of the world's agricultural machinery industry and what a large part engineering science plays in food production, and it will come as a surprise to many to learn that the United Kingdom ranks only fourth of the countries which manufacture agricultural machinery, the first three in order of importance being the United States, Canada, and Germany. In 1930 the exports of agricultural implements from the United States were more than seven times those of the United Kingdom, while Canadian and German builders each exceeded our exports more than two and a-half times. A very considerable portion of these exports goes to British Dominions, but only one-fourth was imported from Great Britain, in spite of the fact that for quality the British products are the finest in the world. The principal reason why British makers of agricultural plant cannot compete with those in the United States and Canada is, of course, the magnitude of the implement industry in those countries, owing to their large home market. In the United States the home market for agricultural implements is several times larger than the export market. Then, again, several of the huge firms in America and Canada produce a "complete line" of machines, so that they can supply dealers and agents with practically all the machines which their customers are likely to require. In that way, and with the aid of an import tariff, competition is largely avoided and British manufacturers are shut out.

In spite of the adverse industrial conditions of the last few years, there have been many developments in agricultural machinery, and the modern farm is becoming more like a factory which requires a higher standard of labour than formerly. Mechanical methods of production are responsible for many changes in the industry and have had an influence upon the general outlook and well being of the farmer, who is becoming less and less dependent upon climatic conditions. The substitution of mechanical and electrical power for muscular effort enables farmers to expedite their seasonal operations, and enhances the quality of their produce. Farm implements must, however, be as simple as possible, and must be capable of operating under adverse conditions while their cost must be low enough to make their limited annual employment profitable. Many of the machines about a farm are used for only a few days throughout the year, and during the remainder of the year they are exposed to conditions which no other class of machinery is expected to withstand. Corrosion is the farm implement's greatest enemy, and manufacturers are making more use of non-corrodible metals and protecting the exposed parts of machines by plating or galvanising. With the faster-moving machinery now employed, better systems of lubrication of the wearing parts are called for than the old-fashioned oil can, and it is interesting to note that implement builders are paying more attention to that branch of design. There will be shown at Warwick mowers with automatic lubrication.

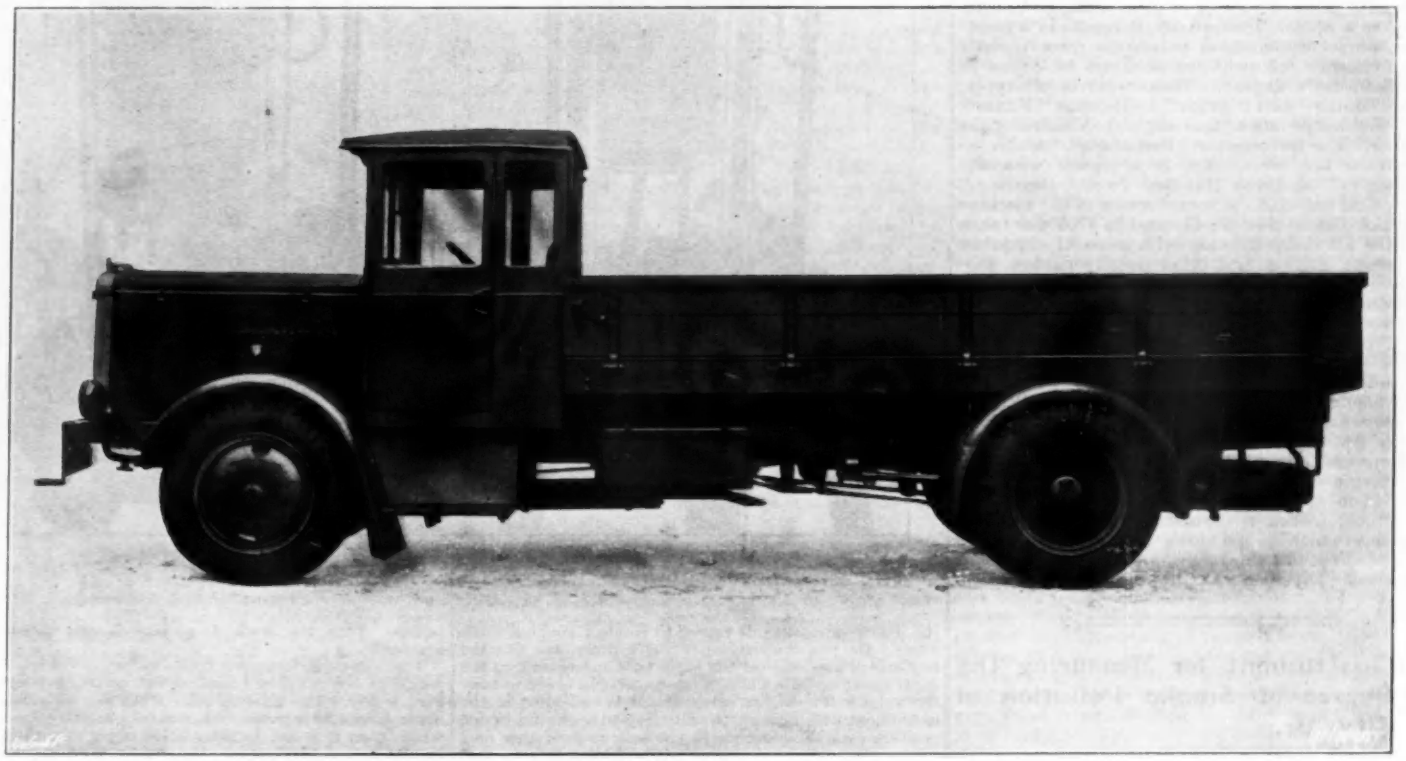


FIG. 1—6-TON CRUDE OIL LORRY—FOWLER

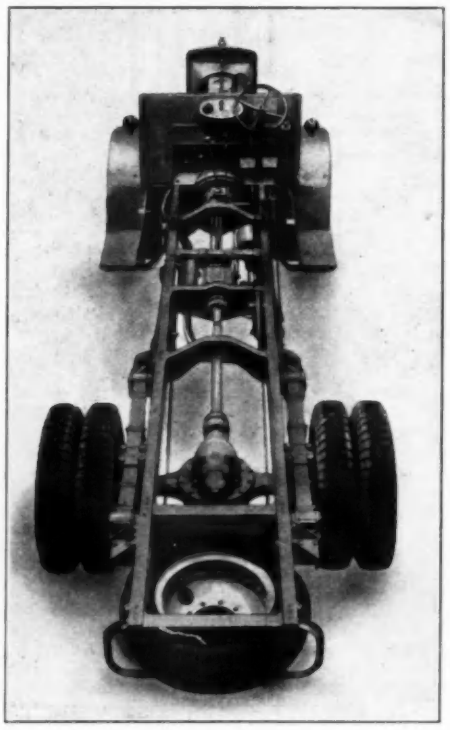


FIG. 2—LORRY CHASSIS—FOWLER

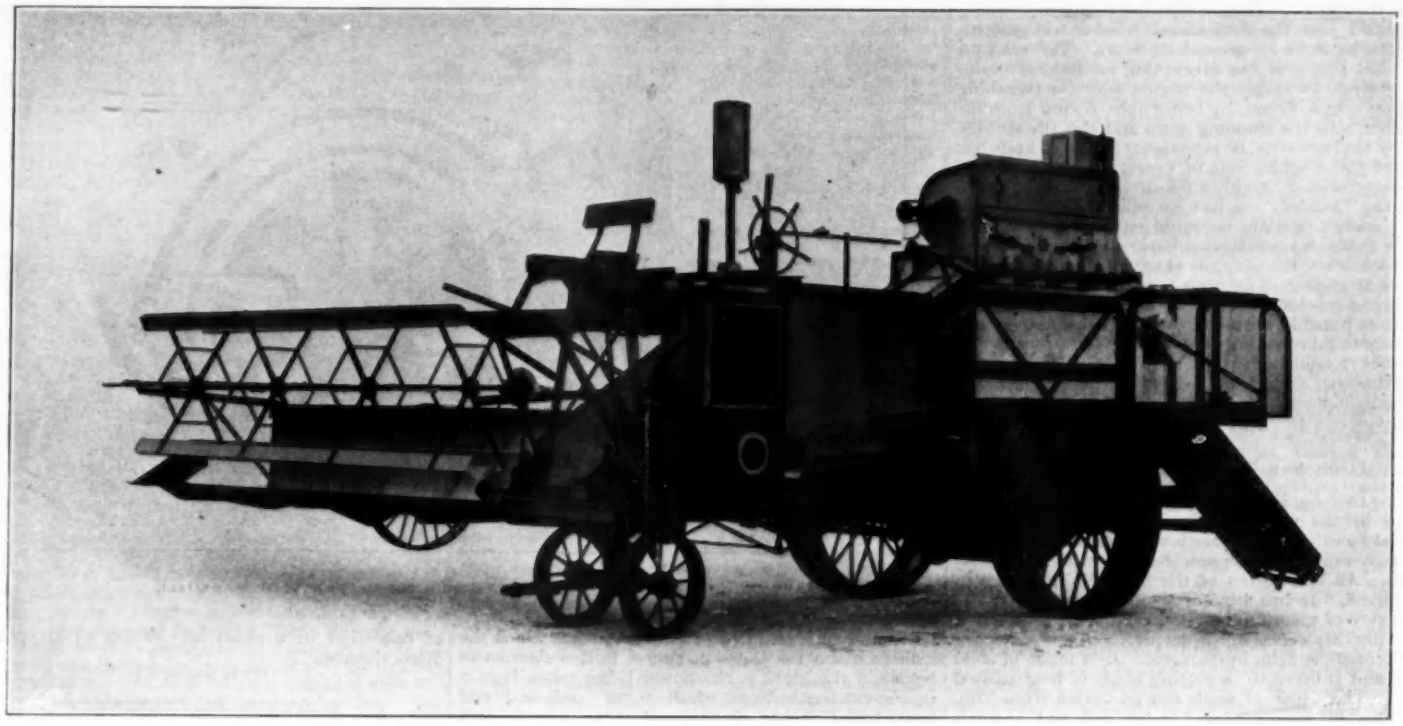
Another feature of the forthcoming Show will be an increase in the number of electrical machines, and the exhibits of self-contained electric lighting plants, specially suitable for farm and estate work, will be found of great interest. The makers of that class of machinery to be shown at Warwick will include Blackstone and Co., Ltd., of Stamford, who will exhibit plants operated by both crude oil and petrol; J. and H. McLaren, Ltd., of Leeds, who will show generating plants driven by McLaren Benz high-speed airless injection engines; Ruston and Hornsby, Ltd., of Lincoln, with crude oil and petrol-paraffin engines; R. A. Lister and Co., Ltd., of Dursley, whose plants are operated by both compression ignition and petrol engines; Petters, Ltd., of Yeovil; the Wolseley Sheep-Shearing Machine Company, Ltd., of Birmingham; Crosley Brothers, Ltd., of Manchester; Fairbanks Morse and Co., Ltd., of London; and the National Gas Engine Company, Ltd., of Ashton-under-Lyne. There will be no exhibits of stationary steam engines, although the employment of steam as the motive agent for heavy haulage work will be exemplified on the stands of William Foster and Co., Ltd., of Lincoln; Fodens, Ltd., of Sandbach; John Fowler and Co. (Leeds), Ltd.; the Sentinel Waggon Works, Ltd., of Shrewsbury; Ransomes, Sims and Jefferies, Ltd., of Ipswich; J. and H. McLaren, Ltd., of Leeds; and Marshall, Sons and Co., Ltd., of Gainsborough.

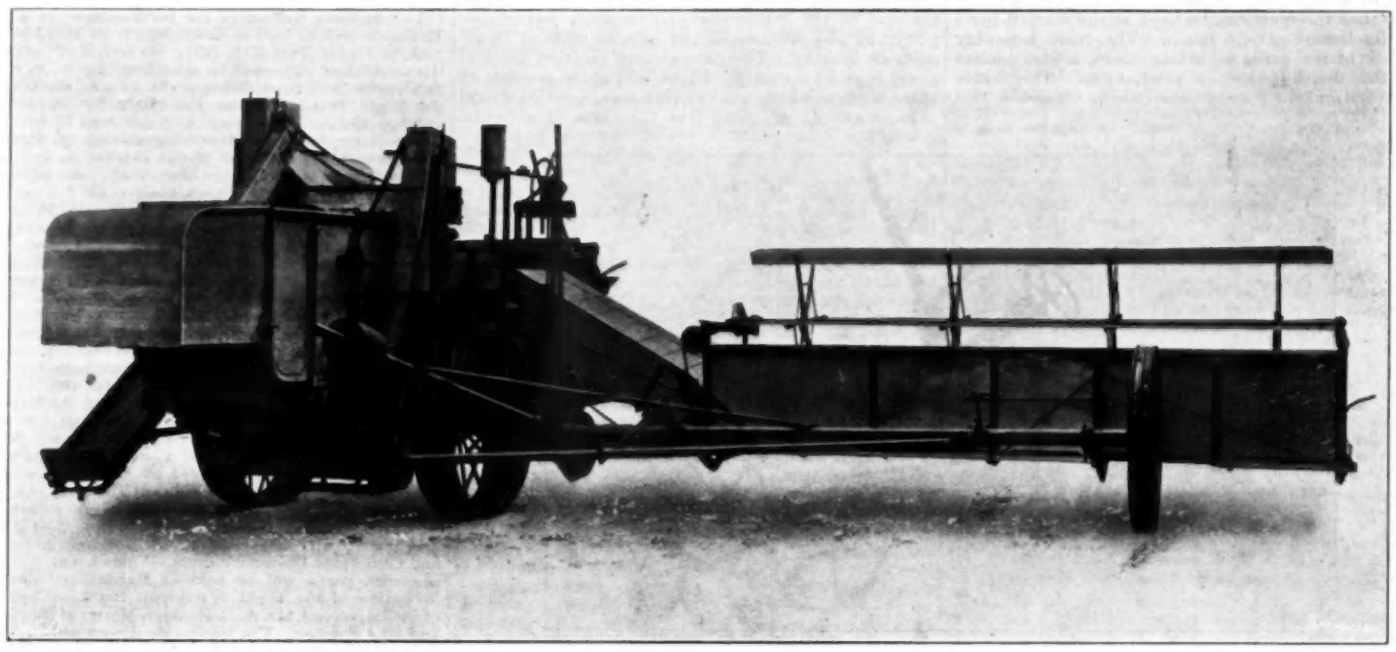
JOHN FOWLER AND CO.

The exhibits of this Leeds firm will cover a wider field of engineering than usual, and will include a crude oil lorry, illustrated in Figs. 1 and 2, two crude oil engines with two and six cylinders respectively, a crude oil cable ploughing engine, a 12-ton compound steam road roller, a crude oil roller 8 tons in

COMBINED HARVESTER AND THRASHER

CLAYTON AND SHUTTLEWORTH, LTD., LINCOLN, ENGINEERS





FIGS. 3 AND 4

weight, concrete mixers, winches and a mast hoist, all of the most recent design. The crude oil lorry which has a capacity of 6 tons, is furnished with interchangeable pressed steel wheels, fitted with giant pneumatic tires, 40in. by 8in. The drivers are twins. The general appearance of this lorry is very impressive. It has an overall length of 25ft., width 7ft. 5½in., wheel base 15ft., wheel track, 5ft. 10⅝in., and a turning circle of 60ft. The body is 15ft. long and 7ft. wide. The engine has six cylinders, 4¾in. bore by 7in. stroke, and develops 90 horse-power at 1400 revolutions per minute, the normal running speed varying between 600 and 1400 revolutions per minute.

The chief features of the engine are a seven-bearing crank shaft, fitted with a vibration damper, aluminium pistons, an air cleaner, a ribbed crank case to assist cooling the lubricant, and Bosch fuel pumps, giving solid injection direct into the cylinders and efficient atomisation. Lubrication of the engine is by means of a gear wheel pump submerged in the crank case, which delivers oil under pressure to all the main and big end bearings and gudgeon pins, and there is an oil filter which is easily removable. The cooling system includes an impeller-type water pump, a fan driven by adjustable V belt and a built-up tubular radiator with an aluminium frame. The clutch is of the multiple dry-plate pattern, with ventilation for cooling purposes. The gear-box provides four road speeds and has an additional two-speed box fitted behind the clutch, so that two distinct ranges of four speeds each, or a total of eight speeds, are provided. The operating mechanism is enclosed in an oil-tight casing and connected to the gear-boxes by rods and levers. The lowest road speed is 3·5 miles per hour, and the maximum 38·4 miles per hour. Universal joints are fitted on the transmission system between the clutch and gear-box, and between the gear-box and the back axle. The axle, which is of the full-floating type, is carried in a one-piece nickel steel forging. The final drive is through worm gearing and the differential is of the four-pinion pattern. The final gear ratio is 7·5 to 1 and the whole of the gearing can be removed from the axle casing as one unit. The front axle is a substantial H section steel forging, with steel stub axles and taper roller bearings in the wheel hubs. The brakes, which are of the internal expanding type, work in brake drums of large diameter, the foot brakes operating on all four road wheels, assisted by servo-vacuum mechanism. The hand brake operates on the rear wheels only. Single-point adjustment is provided for all brakes, as well as individual adjustment on each wheel. The vacuum is obtained by an exhauster driven from the engine, with a separate vacuum cylinder to enable the brakes to be applied when the engine is not running. Another desirable feature of this wagon is the application of forced lubrication to the chassis at all the necessary points.

The cab is comfortable, the seats being upholstered in leather and a central control system is provided. The engine control is by a foot-operated accelerator, while a lever on the dashboard controls the timing of the fuel injection. The fuel tank, which has a capacity of 35 gallons, has a pressure supply from the engine and a tire pump is driven from the gear-box. The engine is started from cold by means of a 24-volt starting motor operated from 12-volt batteries, and on "give" and "take" roads we are informed that with 6-ton loads the fuel consumption averages 10 miles per gallon. Taking the cost of fuel at 6d. per gallon, the cost works out at 0·6d. per mile run.

CLAYTON AND SHUTTLEWORTH.

Amongst purely agricultural machines the combined harvester thrasher to be shown by Clayton and Shuttleworth, Ltd., Lincoln, calls for special notice. As its name indicates, it is a combination in one machine of a harvester and thrashing machine and is practicable where grain may be allowed to become fully ripe in the field and where it is either not necessary to harvest the straw or where the saving of the straw is of secondary importance. The implement, illustrated in Figs. 3 and 4, is entered in the new implement class for silver medals. The machine has a 16ft. cut and an articulated header, capable of cutting, thrashing and dressing simultaneously. It is, we believe, the only appliance of its kind designed and built in the United Kingdom, and has proved successful after exhaustive tests in various parts of the world.

This machine is suitable for either animal or tractor draught, and three men only are required to manipulate it. They are employed as follows :—One to drive the machine ; a second on the pilot platform ; and the third to replace empty sacks for the dressed grain. The filled sacks are automatically shot off the machine on to the ground. The machine has been considerably simplified and the articulated header will accommodate itself to all ground contours. The man on the pilot platform has everything mechanical under his control, including the engine and the thrashing portion. In addition, by being able to view from his position both the standing grain and also the stubble left by the harvester, he can raise or lower the knife bar or put the machine out of operation whenever the necessity arises. Another feature of this machine is that the " header " can be very quickly detached from the thrasher portion, mounted on a trolley, and be made ready for road transport. The width of the machine when travelling is then only approximately the same as that of an ordinary binder or a standard thrashing machine. The harvester thrasher is fitted, as far as possible, with ball or roller bearings and has grease gun lubrication.

Other machines to be shown by Clayton and Shuttleworth are a standard type thrashing machine and a light-weight elevator, with a delivery height of 21ft. 6in.

JAMES AND FREDERICK HOWARD, LTD.

Two new implements which will be on this firm's stand in the machinery-in-motion section call for special mention. They are a mole drainer for tractor haulage and a new grass harrow with reversible teeth. An illustration of the mole drainer is given in Fig. 5. It has been designed to overcome the tendency of mole drainers to swing from side to side or to dig themselves in too deeply.

The mole is 2¼in. in diameter. It is made of solid steel and is fitted to a cutting blade of heat-treated steel. The depth of work can be varied from 12in. to 20in. by means of a hand wheel and a screw adjustment, which can be operated while the implement is in work, the advantage of this arrangement being that the mole can be kept at the correct level for the batter of the drain. The mole assembly consists of the mole, a cutting blade, a disc coulter and the depth adjusting mechanism. The whole is pivoted on the main frame, which comprises two parallel angles with a space between for the mole assembly to swing up and down over a quadrant as it is raised or lowered into work. The draught bar, through which the pull of the tractor is transmitted, is attached to the mole assembly, and a forward or backward movement of the tractor is used to swing the mole into, or out of, work. Strong catches are provided to hold the mole assembly in the raised or lowered position. To put the mole into work, a catch, which is operated by a hand lever, is released, the tractor is backed and the mole drops automatically into the working position, where it is held by the lower catch. Two wheels at the front are mounted on a cranked axle coupled by a connecting-rod to the mole assembly. As the mole swings downwards the wheels are raised into their working position. The mole is raised from work by releasing the catch, when the forward movement of the tractor pulls the mole upwards and causes the wheels to drop into the travelling position. A two-wheel carriage is supplied for travelling on the road.

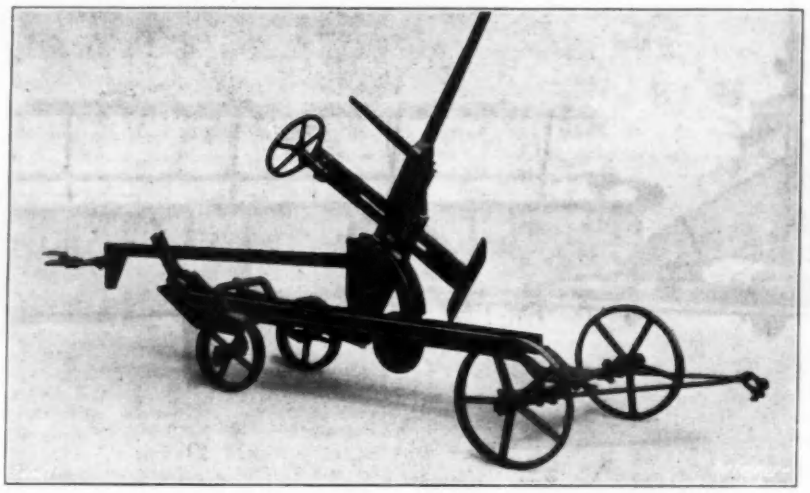


FIG. 5—MOLE DRAINER—HOWARD

MARSHALL, SONS AND CO., LTD.

On the same stand as their allies, Clayton and Shuttleworth, Marshall, Sons and Co., Ltd., Gainsborough, will have a representative display of machinery including a 6 nominal horse-power single-cylinder steam traction engine, a 44 brake horse-power cold-starting class H oil engine, and a " Manumit " petrol-driven 16-cwt. motor roller. There will also be on view compression ignition tractors of both agricultural and industrial types, both of which are operated by 15–30 B.H.P. two-stroke single-acting horizontal engines. One of the advantages which the makers claim for these machines is the absence of bevels in the gearing, the power being taken from a square-cut toothed gear wheel on the crank shaft and transmitted through a train of straight square-cut gear wheels to the rear axle. Power for belt work in both machines is taken direct from a large pulley on the end of the crank shaft to transmit full engine power at 550 revolutions per minute without intermediate gearing. The compression ignition tractor, apart from its travelling wheels and axles, consists of three main sections, viz.: engine case, gear case and rear axle housing the three sections being firmly bolted together to form the complete unit. This allows for what is termed three-point suspension, viz., rigidity of both rear wheels and the other point pivoted at the middle of the front axle so as to allow free movement vertically for either of the front wheels according to the surface of the ground, without throwing undue stress on any part of the tractor. The bore and stroke of the engine are 8in. and 10½in. respectively. The normal running speed is 550 revolutions per minute and the maximum power on the belt 30 horse-power. The road speeds are 2, 3 and 4 miles per hour and on the reverse 2·5 miles per hour. In the case of the agricultural tractor—Fig. 6—standard steel wheels are fitted with angle skid rings for the front wheels and spade lugs or angle strakes for the rear wheel, to suit customers' requirements. The road haulage tractor is fitted with single rubber-tired front wheels and twin rubber-tired rear wheels with drop-in grips. On a 15 per cent. gradient the road tractor will haul 4½ tons, on a 7½ per cent. gradient 9 tons, and on a 3 per cent. gradient 15 tons. Its weight is 3½ tons. Three forward speeds and reverse are provided for each tractor, but in the case of the road tractor the speeds are higher than for the agricultural tractor. Another important exhibit will be the 8-ton compression ignition road roller. It has a two-cylinder high-speed four-stroke engine of the cold-starting type, which runs on cheap heavy fuel oils at the remarkably low consumption of 0·42 lb. per B.H.P. per hour. It has a quick reverse action for rolling on asphaltics, three speeds in either travel direction, and is claimed to combine strength of construction, simplicity of mechanism, and ease of operation in a clean line design of exceptional attractiveness.

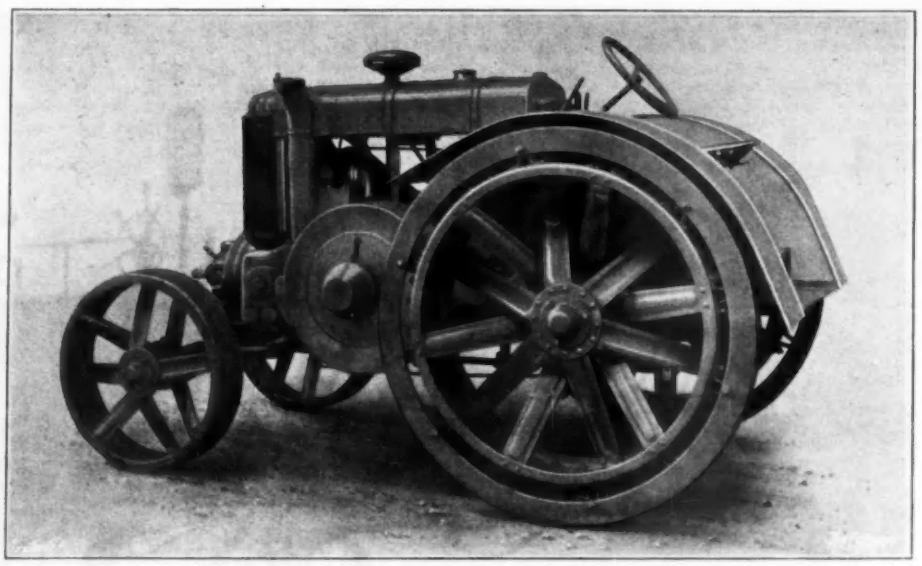


FIG. 6—C. I. OIL-ENGINED AGRICULTURAL TRACTOR—MARSHALL

(To be continued.)

INSTITUTION OF MECHANICAL ENGINEERS.

THE Summer Meeting of the Institution of Mechanical Engineers will be held at Cambridge from Monday, July 13th, to Friday, July 17th, 1931. On arrival at Cambridge the secretaries' office will be open from 3 p.m. to 6 p.m. in Gonville and Caius College. At 10 a.m. on Tuesday, the Right Worshipful the Vice-Chancellor of the University, Mr. A. B. Ramsay, and members of the Cambridge Reception Committee will welcome the President and Council and members of the Institution and ladies in the Senate House of the University. At 10.30 a.m. Professor C. E. Inglis, F.R.S., will deliver an address on " Cambridge as a Place of Education." At 11 a.m. Mr. H. N. Gresley will read a paper on " Locomotive Experimental Stations." A discussion will follow. From 11 a.m. to 12.30 p.m. the ladies will walk through the " Backs " of the Colleges under the guidance of members of the University. Luncheon will be served in King's College and St. John's College at 1 p.m. From 2.30 p.m. to 5 p.m. visits will be paid to the various Colleges under the guidance of members of the University. A reception and dance will be held in the Guildhall from 8 p.m. to 12 p.m., by invitation of the Worshipful the Mayor of Cambridge, Councillor Edwin Jackson, and the Mayoress.

On Wednesday, July 15th, visits will be paid to works and places of interest. In the morning visits will be paid to the Cambridge Instrument Company ; Chivers and Sons' jam factory and orchard at Histon ; Eastwoods Cement Works, Barrington ; Edward Towgood and Sons ; and Sawston Village College, Rural Social and Educational Institute. Further visits will be paid from 2.30 p.m. to 3.45 p.m. to the Low-Temperature Research Association and Cambridge University Press. From 4 p.m. to 6 p.m. a garden party will be held at Magdalene College by invitation of the Right Worshipful the Vice-Chancellor of the University, Mr. A. B. Ramsay, Master of Magdalene, and Miss Ramsay. The Institution dinner will be held at 8 p.m. in the Banqueting Hall, University Arms Hotel.

On Thursday, July 16th, there will be alternative whole-day visits, and in the evening from 8.30 to 11 p.m. a conversazione will be held at the Engineering Laboratory, by invitation of Professor C. E. Inglis and Mrs. Inglis and the staff of the University Engineering Department.

On Friday, July 17th, alternative whole-day visits will be paid to Bury St. Edmunds and Wretham Hall, Henlow and Letchworth, and Peterborough.

B.E.S.A. SPECIFICATIONS.

All B.E.S.A. Specifications can be obtained from the Publications Department of the Association at 28, Victoria-street, London, S.W. 1. The price of each specification is 2s. 2d. post free, unless otherwise stated.

TUBULAR TRACTION POLES.

A new edition of British Standard Specification No. 8 for Tubular Traction Poles has just been published. It differs from the 1927 edition in that it includes poles 33ft. long, whereas previously only 31ft. poles were included. This extension has been found to be necessary in view of the increasing use of the trackless trolley omnibus, for which the longer poles are required on account of the greater number of contact wires that have to be supported. As regards the 31ft. poles, the specification remains as before, provision being made for four different strengths. Three strengths of 33ft. poles are provided for, *i.e.*, medium, heavy, and extra heavy, and dimensions for outside diameters, lengths of section and minimum thickness are given, while details of the drop tests and bending tests are also included. Information regarding the weights of the various sizes of poles is given in an appendix.

Railway and Road Matters.

THE peculiar circumstances that attend the proposed closing of the Winsford branch of the Cheshire Lines Committee were mentioned in this column on January 9th last. The proposal is objected to on the ground that when a similar proposition was put forward forty years ago, and on the same ground as now, namely, that the branch did not pay, the Railway and Canal Commission made an Order on February 25th, 1891, that was, in effect, one for keeping it open. The Commission has now given permission for a notice of motion to rescind or vary the Order.

A "ZEPPELIN on Wheels," as it is called, which is the invention of a German engineer, Herr Kruckenberg, has covered the 160 miles between Hamburg and Spandau —just outside Berlin—in ninety-six minutes, as compared with the three and a-half hours taken by the fastest railway train. The highest speed reached on the trial run was 140 m.p.h., which was attained on a long straight stretch, and the time table was kept exactly, the "Zeppelin train" leaving Hamburg at 3.27 a.m. and arriving at Spandau at 5.03 a.m. An aeroplane that followed the train from Hamburg was behind most of the way, but caught the train up towards the end of the journey.

THE complete electrification of the Stockholm–Malmoe railway line will be finished within the year 1933, according to a statement by Axel Granholm, Director-General of the Swedish State Railways, in a recent lecture held before a society of engineers at Malmoe. The stretch is 599 kiloms. long, while the already electrified cross-country line Stockholm–Gothenburg has a length of 456 kiloms. Mr. Granholm hopes for the future electrification also of the west coast railway from Gothenburg to Malmoe, 315 kiloms. long, and the Norrland line, Stockholm to Aange, 616 kiloms. The cost of electrification of the two last-mentioned stretches with locomotives would require in all a sum of 79,200,000 kronor (£4,400,000).

THE railways of the United States have decided to ask the Interstate Commerce Commission to authorise a 15 per cent. increase in freight rates. This increase would result on the basis of present figures in an annual increase of 400,000,000 dollars (£80,000,000) per annum. It is pointed out that, even with the increased revenues asked for, the carriers this year will earn less than 4 per cent. on the value of their property, a return much below the 5½ per cent. prescribed by law as a fair return. The seriousness of their position is shown by the fact that, even with drastic economies, they have been forced to defer expenditure on the maintenance of their properties. This item is beginning to mount to a formidable total.

IN view of the likelihood of many double lines in this country being, in the near future, converted to single tracks, further reference than that in our issue of June 12th, should be made to the objections of the local authorities of Waterford to such conversion of the Great Southern system between Fiddown and Waterford. There was one unusual feature in this case; it was that when the Great Southern and Western obtained powers, in 1900, to amalgamate several railways in the South of Ireland, one condition laid down in the empowering Act was that there should be no discrimination between the various ports and harbours affected by the amalgamation. That fact, presumably, led to the objection that in singling an approach to Waterford discrimination was shown in comparison with, for instance, Cork. The Railway Tribunal considered that in this and other respects Waterford was adversely affected. The railway company appealed and the Supreme Court has sanctioned the appeal; not, however, on the grounds objected to, but upon an estimation of the reasonable requirements of the Waterford traffic.

THE Board of Trade export tables for April show the value of railway material sent overseas during the first four months of the present year to be as follows, the corresponding figures for 1930 and 1929 being added in brackets:—Locomotives, £790,509 (£1,243,573, £921,683); rails, £452,046 (£895,998, £986,549); carriages, £651,095 (£528,624, £619,221); wagons, £500,583 (£979,303, £927,509); wheels and axles, £75,727 (£110,048, £140,497); tires and axles, £119,922 (£231,183, £189,747); chairs and metal sleepers, £104,077 (£279,444, £152,649); miscellaneous permanent way, £189,029 (£288,293, £374,642); total permanent way, £964,915 (£1,846,488, £1,903,801). The weight of the rails exported was: 55,227 tons (103,886 tons, 117,401 tons); and of the chairs and metal sleepers, 12,679 tons (29,708 tons, 15,478 tons). During the month of April last locomotives to the value of £134,623 were shipped, which included: India, £71,547; the Argentine, £23,234; other countries than the Argentine in South America, £12,405. The value of the rails sent overseas in the same month was £197,850, and included: South Africa, £160,146; India, £10,587; British West Africa, £9010; the Argentine, £3885.

THE proceedings in Committee, when before the House of Lords, of the Great Western Railway Bill, consequent upon that company seeking powers to take a financial interest in any wagon company which may be formed for the sole purpose of providing mineral wagons for the use of traders, have drawn attention to the steps taken in order to encourage the coal trade to use 20-ton wagons. In that relation praise was given to the Great Western for granting a rebate of 5 per cent. on the carriage rate on coal conveyed wholly over its system in 20-ton wagons, and, further, a rebate of 1d. per ton from the tipping and weighing charges. The credit for this idea must, however, be placed in another quarter. Speaking at the Institute of Transport on February 5th, 1923, Mr. H. N. Gresley said, in his paper on "Wagon Stock on British Railways," quoted in a leading article in our issue of the 9th idem., "if the railway companies could see their way to adjust their rates for coal so as to favour the 20-ton wagon, there would be an immediate inducement to the colliery owners to build, or hire from the railways, wagons of this capacity, and a consequent demand, which the dock owners could not resist without jeopardising their income, to provide suitable tipping appliances for such wagons." Mr. Gresley added that he was only the mechanical engineer of a railway company, and was speaking without any authority from those who were responsible for fixing the rates. It was not, however, until nearly eight months later that the Great Western made the offer referred to.

Notes and Memoranda.

IT is estimated that if the Nelson River, which flows into Hudson Bay, were fully developed, it would produce over a million horse-power.

FAT men should be popular with power station engineers according to the results of investigations carried out on the results of electric shock by Dr. W. B. Kouwenhoven, of the Johns Hopkins University of America. He has found that not only in the case of men, but also in that of animals, the victim of a specific shock was less affected as his, or its—sex produced no difference—bulk was increased. His investigations also showed that at about 500 volts both D.C. and A.C. were equally fatal. Below that voltage the results of exposure to A.C. were the more serious.

IN laying a length of vitrified clay sewer in Seattle, U.S.A., the joints were made by casting into the sockets and over the spigots rings of asphalt mixture. The mixture used consisted of 60 per cent. of grog and 40 per cent. of asphalt. The rings were cast in place before the pipes were dispatched. When the pipes were laid in the trench they were pushed home with a lever in the case of the smaller sizes and with a jack for those over 21in. in diameter. It was found that even if the pipes were laid under water the joint became a homogeneous mass within an hour.

THE use of galvanised sheets for roofing was discussed by J. D. Conover, secretary, and G. C. Bartells at the twentieth annual meeting of the National Association of Sheet Metal Distributors at Pittsburgh, Pa. According to Mr. Bartells, a great variation in sheets taken from farm roofs was to be noted, many of them being in excellent condition and showing little or no rust after fifteen to thirty-five years' exposure to the weather, while others which had been exposed only a few years showed pronounced rusting and deterioration. The service thus given had been correlated with the thickness of the zinc coating, as determined by sampling the covered end of the sheets, and superior service and long life had in every case been found to be related to a fairly heavy zinc coating.

THE failure of paint films on certain building materials has been shown by the investigations of the Building Research Station of the Department of Scientific and Industrial Research to be due in many cases not to any defect in the paint itself, but to the nature or condition of the material to which it is applied. A bulletin issued by the Department, which can be obtained from H.M. Stationery Office, price 2d., sets forth briefly for the convenience of architects, builders and decorators, the inherent causes of such failures, and indicates the precautions to be taken to avoid defects such as blistering, peeling, flaking, softening, or stickiness, and bleaching or discoloration. A detailed report of the investigation and of the results obtained is being prepared, and will be published in due course.

HERE is the opinion of the local correspondent of the *South African Mining and Engineering Journal*, on the condition of affairs at Durban: "Both the marine and general engineering industries at coastal centres, Durban particularly, are showing perceptible improvement. At the latter centre, constructional engineering forms an important branch of the town's industrial activities, and in this respect some big business has lately been handled. On the other hand, far greater activity is noticeable in marine engineering, and as a 'repair' depôt, the port of Durban is one of considerable importance. Not only has Durban one of the biggest graving docks in the world, but the local marine engineers have shown themselves capable of tackling the very biggest of repair jobs. It is said that local firms can do anything for a ship that can be done overseas. Indeed, firms have even built vessels there, although, of course, they were not of large dimensions. As an indication of Durban's engineering development, it is of interest to observe that the value of machinery operating in this field is nearly £500,000."

CERTAIN promoters of hydro-electric development in the province of Quebec and some political leaders in the province of Ontario have, says Mr. G. H. Challies, in the *Canadian Engineer*, recently advanced a simple, but an unacceptable, proposal that power should bear the total cost of those portions of the waterway project between Lake Ontario and Montreal harbour. They profess to believe that the 5 million horse-power capable of production in this reach of the St. Lawrence can be sold on either side of the boundary at a price that would yield a handsome return on the total cost of the completed waterway. But they deliberately overlook certain essential factors—that St. Lawrence power must compete with power which can be developed much more cheaply, easily and quickly from other sources; that it will require many years to absorb the huge quantity of power which will be released; that, hitherto, and everywhere else on both sides of the boundary, navigation improvements have been considered proper charges upon the Federal exchequer, not only on account of constitutional reasons, but because the resultant benefits have been national.

A NEW signalling device for shaft mines with a talking circuit between cage or skip and the engine-house is described in an information circular of the United States Bureau of Mines, Department of Commerce, written by L. D. Stewart and E. V. Potter, jun. There has been a great need for a signalling system that could be operated from the cage, and several successful methods have been developed. However, none is as complete as the method described, which is believed to be the only one with a talking circuit, a feature which in itself is a great advantage. Two loud speakers are installed in the engine-house —the cage loud speaker, which is always in service, and the skip speaker, which is used when required. With this system it is possible to signal the engineer from both cage and skip from any place in the shaft, whether or not the cage or skip is moving, and it is possible at all times to talk with the engineer by using the telephone. Another feature is the safety switch connected with the rope in the bonnet of the cage. This switch is normally open, but closes and automatically gives the stop signal whenever the rope slacks, which is a decided benefit if the cage becomes stalled in the shaft when being lowered.

Miscellanea.

THE American Secretary of War has decided that bridges over the Hudson River in the New York district must have a clearance at the centre of the span of 200ft.

A MEMORANDUM containing hints for the guidance of commercial visitors to Finland has been prepared from information received from the British Consul at Helsingfors. United Kingdom firms interested may obtain copies of the memorandum on application to the Department of Overseas Trade, 35, Old Queen-street, London, S.W. 1, quoting No. C.3552.

IN the sitka spruce Canada possesses one of the most valuable woods used in aeroplane construction. There are few woods of its great lightness to equal it in strength, toughness and resiliency, and there is said to be no other wood with these combined qualities which is available in large sizes and quantities, comparatively free of knots and other defects.

A NEW clause, which is supplementary to the alterations and additions dated May 15th, 1930, has been inserted after Clause L of Regulation 69 (Distribution Boards) in the ninth edition of the I.E.E. Regulations for the Electrical Equipment of Buildings. Copies of the new clause can be obtained free of charge from the Secretary of the Institution, Savoy-place, Victoria Embankment, London, W.C. 2, for insertion in existing copies of the Regulations.

THE Dominion Bureau of Statistics at Ottawa, in a preliminary report just received at Canada House, Trafalgar-square, London, S.W. 1, intimates an increase of 10 per cent. in the output of central electric stations in Canada during the year 1929. The total output recorded was 17,962,515,000 kWh, as compared with 16,337,804,000 kWh in 1928. Output has been increasing year by year, the percentage given in 1928 being 12, while those in 1927 and 1926 were 20 per cent.

Two "Charles R. E. Bell Fund" Senior Travelling Scholarships of £150 each have just been awarded to Robert L. Howlett and Laurence A. Lings by the Commercial Education Committee of the London Chamber of Commerce. These Scholarships were instituted for the purpose of encouraging the study of modern foreign languages, by enabling the holders to live abroad for a period of not less than six months. Two further Travelling Scholarships of £150 each are offered by the Chamber for competition in 1932.

SOME five hundred aeronautical instruments were tested last year for the Royal Canadian Air Force by the Physical Testing Laboratory of the Topographical Survey, Department of the Interior. Included among these instruments were altimeters, air speed indicators, engine revolution indicators, thermometers, pressure gauges, and aeronautical compasses. The tests applied are comprehensive enough to observe what each instrument will do under any condition it might meet; even, if necessary, subjecting it to a temperature as low as 40 deg. below zero.

THE start of a return to prosperity for British Columbia's great lumber industry is seen in the placing of orders for 4,000,000ft. of mining timber for Australia and 1,500,000 railway crossing timbers for England. According to an official statement issued by Hon. N. S. Lougheed, British Columbia's Minister of Lands, the sale of the above quantity of mining timbers for Port Pirie, in Australia, is the first order of this nature received by British Columbia mills for a number of years. The order for railway crossing timbers was secured from the London and North-Eastern Railway.

AT the forthcoming Shipping, Engineering and Machinery Exhibition, which will be held at Olympia on September 10th–26th, the Machinery (Machine Tool and Woodworking) Importers' Association has taken the whole of the far end of the main hall, and one of the most important exhibits of machine tools which has been staged, apart from the exhibition of the Machine Tool Association, will be arranged there. A special effort has been made to ensure that practically the whole of the machines exhibited shall be shown in motion. Many new machines which have not previously been exhibited will be on view.

As one interested in the attempts which are being made to remedy the chaotic state of transport in this country, Mr. G. B. J. Athoe, of the Incorporated Association of Architects and Surveyors, says that he would like to call attention to a national conference of local authorities which has been called by the Leicester City Council to discuss canal development. The question of road congestion and damage by heavy traffic is bound to crop up, and is of vital interest to architects of houses adjacent to main roads. "May I," he says, "suggest therefore that the conference would be a fitting occasion to discuss national transport as a whole? So far, I understand, no invitation to the conference has been issued to representatives of the three great inland carrying systems—the railways, the roads, and the canals. As it is surely of the utmost importance that some measure of agreement should be reached by these three interests as to the types of traffic for which they should individually cater, I should like to suggest to the Leicester City Council that invitations should be extended to them."

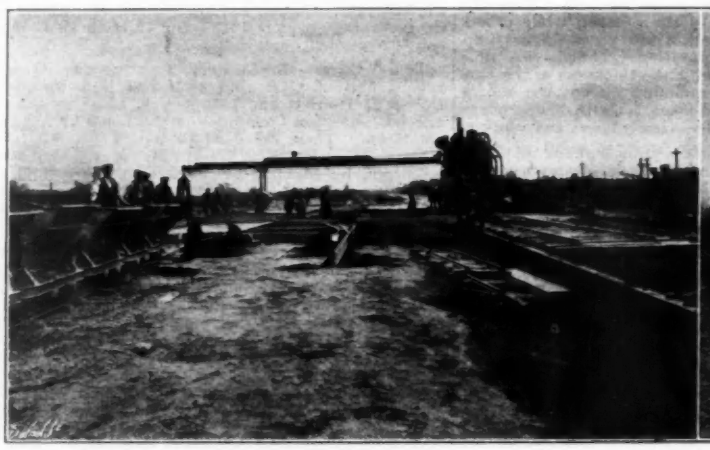
A PROSPECTUS relating to an international electrical congress to be held in Paris in July, 1932, has been issued. It is now fifty years since the first electrical international congress was held in Paris, and at that congress the principal decisions were taken regarding the electrical units. It is proposed at the 1932 congress to sum up the work done in electrical science and industry during half a century and to submit a general survey. The congress will be in thirteen sections, including one on miscellaneous applications, and another on the history of electricity, &c. The main sections deal with the science of the subject; measurement; generation, transformation and distribution of electrical energy; electric traction; electric lighting and photometry; electro-chemistry and electro-metallurgy; radio, &c. The congress is being organised by La Société Française des Electriciens, La Société Française de Physique, Le Comité Electrotechnique Française, and L'Union des Syndicats de L'Electricité, under the auspices of La Commission Electrotechnique Internationale, 134, Boulevard Haussmann, Paris.

THE LIVERPOOL-EAST LANCASHIRE ROAD

(*For description see page 2.*)

MOSS BANK BRIDGE

WALKDEN ROAD CULVERT



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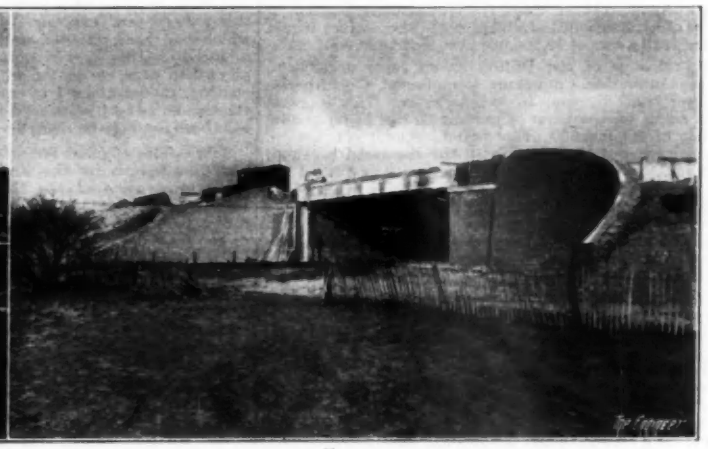
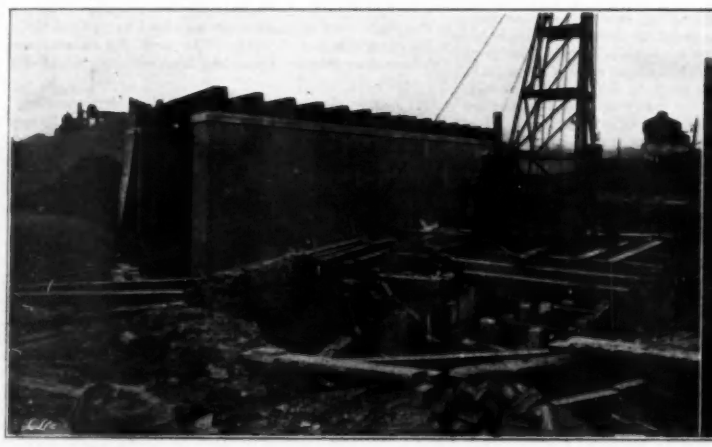


COLLIERY RAILWAY BRIDGE "A"



COLLIERY RAILWAY BRIDGE "C"

BEDFORD BRIDGE

MILLINGFORD BROOK CULVERT

CARR MILL BRIDGE

The Engineer

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THE ENGINEER.

VOL. CLII. No. 3938

JULY 3, 1931.

The Efficiency of Steam Nozzles.

FOLLOWING the presentation of the sixth and final report of the Steam Nozzles Research Committee of the Institution of Mechanical Engineers, we published in our issue of March 7th, 1930, a letter from a correspondent in which questions were raised concerning the validity of the Committee's experimental methods. The two papers —one by Mr. Oakden and the other by Messrs. Hodkinson and Devey—which we reprinted in last week's issue, may be taken as the Committee's reply to our correspondent's criticism. They do not, in our view, provide a satisfactory reply to that criticism. We have therefore decided to take upon ourselves responsibility for the continuation of our correspondent's argument. The point in debate is capable of simple statement, although upon the way in which it is decided hangs the value of much of the Committee's work. The Committee set forth to measure the efficiency of steam nozzles. In practice, it measured the velocity coefficient—that is to say, the ratio of the mean actual velocity of the jet to the theoretical velocity. The efficiency of the nozzle was taken to be the square of this velocity coefficient. Our correspondent argued that this procedure could be regarded as rational only if the velocity of the steam were uniform across the whole area of the jet. In the case of an incompressible fluid, such as water, the square of the velocity coefficient, it was pointed out, would be less than the efficiency of the nozzle, the efficiency being defined as the ratio of the energy in the jet at exit to the energy at inlet. In the case of a compressible fluid, such as steam, our correspondent added, additional complexity was introduced by virtue of the fact that the density of the fluid would vary with any variation of velocity across the area of the jet. He envisaged the possibility that the effect of the varying density of the steam filaments might cancel out the effect of their varying velocity. He asked for some assurance that the points he had raised had been duly considered, and sought some proof that they were without material effect on the accuracy of the Committee's results. The two papers which are now before the members of the Institution of Mechanical Engineers for discussion in writing cannot be accepted as closing the debate.

Both Mr. Oakden and Messrs. Hodkinson and Devey admit the truth of the elementary contention that if the velocity across a jet is not uniform, the square of the velocity coefficient cannot be equal to the efficiency of the nozzle. They naturally agree with our correspondent that the velocity is not uniform across the section of any steam nozzle jet. The ground is therefore cleared in so far that the possibility of the existence of discrepancies in the Committee's results is admitted. The two papers then proceed in different ways to show that the discrepancies are of no importance. Mr. Oakden's method of demonstrating this conclusion is to attack the accepted definition of efficiency. He argues that the "theoretical efficiency"—the ratio of the energy in the jet at outlet to the energy at inlet—cannot be discovered by any known form of instrument, and that in any event turbine designers are not concerned with this theoretical efficiency, but with a quantity which he calls the "practical efficiency." As the reader will no doubt anticipate, Mr. Oakden then "proves" mathematically that the "practical efficiency" is identical with the square of the velocity coefficient as measured by the Committee. His proof turns upon an expression for the efficiency of the blading on which the steam is received after it has left the nozzle. In other words, he maintains that the efficiency of the nozzle is dependent upon the use made of the steam after it has left the nozzle. The same principle, if admitted into other branches of engineering, would create nothing but confusion. It is exactly equivalent to saying that the efficiency of a turbine or oil engine is dependent upon and cannot be judged apart from the efficiency of the generator or other machine which it drives. If Mr. Oakden's argument is to be accepted, how are we to determine the efficiency of a steam jet—such as that of an ejector—which is to be used dissociated entirely from blading? Difficulties may exist in the measurement of the theoretical efficiency of a jet and in making use of the theoretical figure in practical design. We should, however, not seek to evade them by introducing a faulty and illogical principle. Messrs. Hodkinson and Devey, in the first instance, had resort to experiment. They measured the velocity distribution over the exhaust face of two nozzles. Thereafter they assumed a certain law, indicated by the experiments to hold good, for the fall of velocity towards the boundaries of the nozzle. The form of this law was such as to permit them to analyse the discrepancy mathematically. In effect, their conclusion is that the discrepancy in the Committee's results is very small, less than 1 per cent., we are asked to believe, in the case of a fairly efficient nozzle. This conclusion does not impress us as being above criticism. We would remind them that the Committee's object was to determine the efficiency of steam nozzles, and not their velocity coefficients. The point in debate is not the discrepancy between the square root of the efficiency and the velocity coefficient, but between the efficiency and the square of the velocity coefficient. In the symbols which they use the discrepancy with which we are concerned is not $(\sqrt{\eta} - \varphi)/\varphi$ as they imply it to be, but the quantity expressed by $(\eta - \varphi^2)/\varphi^2$. The difference is material, so material, in fact, that every discrepancy set forth in the paper should be multiplied by two in order to obtain the discrepancy with which we are really concerned. Setting aside an obvious misprint in the paper as circulated to the members, we cannot agree that the authors are justified in the manner in which they integrate their assumed law of velocity distribution in order to obtain expressions for the mass flow, the total momentum, and the total kinetic energy. The integrations are based on the assumption that the density of the steam is uniform across the jet section. They admit that the velocity of the filaments composing the flow is variable, but quite arbitrarily, and without offering a word of justification, they assume that density is uniform. In other words, their results, if they have any applicability at all, are applicable to the flow of water through a nozzle, not to the flow of steam.

It may perhaps be contended that the discrepancy which we are discussing is really a matter of small importance in practice. We do not admit that it is, but even if it were so it would be a subject for comment that it should have been allowed to creep, without a word of acknowledgment, into the Committee's work. Still more would comment be called for concerning the manner in which the introduction of the discrepancy has been defended. Both papers convey an impression of an attempt to justify the Committee's procedure, even to the extent of strain-

ing logic and mathematics. The discrepancy is not, however, of small importance. In absolute value it may seem small. Messrs. Hodkinson and Devey admit that it may in some cases result in an error of about 1 per cent. in the velocity coefficient, which means an error of 2 per cent. in the nozzle efficiency as determined by squaring the velocity coefficient. It has to be remembered that this error applies to a number lying between 0·8 and 1·0. As between one nozzle and another, the Committee was concerned with variations in form and character which improved the efficiency from, say, 88 per cent. to 90 per cent., or by some similar step. It now appears that the experimental methods employed involve the possibility of a discrepancy of the same numerical order of magnitude as the alleged improvements. We expect it will be said that a knowledge of the absolute efficiencies of two nozzle forms is not of great importance, and that in practice all that is required is some means of determining their relative efficiencies. That point may be conceded, but its concession cannot, without sacrifice of prestige, be employed in defence of the Committee's methods. From the outset it has been claimed that those methods were such as to enable the absolute efficiencies of nozzles to be measured. It has been shown, and is now admitted, that they involve a discrepancy in that direction. It still remains to be proved that they are free from discrepancy in the measurement of relative efficiencies.

Regenerative Heat Engines.

IT is proved in every text-book on thermodynamics that no heat engine can be more efficient than the one devised by Carnot. The theoretical perfection of the Carnot engine has been so thoroughly impressed upon students that they are apt to imagine that the heat cycle on which it works is the only one permitting the maximum of efficiency. Carnot, however, is responsible for no such claim. The essence of his teaching was that, for an engine to be capable of turning into work the greatest possible fraction of the heat it receives its action must be thermodynamically reversible. To illustrate the point, he conceived an engine which would work on a particular cycle involving no irreversible operations. The indicator diagram of his cycle consisted of two isothermals joined by two adiabatics. The isothermals are necessary to any perfect engine because they represent the condition that the working substance is maintained at the highest temperature of the cycle all the time that heat is being put into it, and at the lowest temperature while heat is being rejected. To get the substance from its hot to its cold state, and *vice versâ*, Carnot caused it to be expanded and compressed adiabatically. Thus no heat could enter or leave it during the temperature changes, which is in accordance with the condition just mentioned. The adiabatic parts of the cycle, however, although they are reversible, are not essential to reversibility. Provided, of course, that there is no degradation of energy by turbulence, reversibility is completely attained if heat is never allowed to flow between the working substance and any conducting material except when these are sensibly at the same temperature. There must, in short, be no unused temperature drop in either direction. Even with this restriction it is still possible for the working substance to undergo the required temperature changes without adiabatic expansion or compression. To cause it to drop from the higher temperature to the lower, all that is necessary is that it shall give up its heat by flowing through a regenerator maintained at a suitable temperature gradient. It emerges at the lowermost temperature of the cycle, and after rejecting the heat thermodynamically necessary by an isothermal compression, it is raised again to the upper temperature by flowing backwards through the regenerator. It then takes in heat from the outside source at this temperature during its isothermal expansion and so the cycle is repeated. An engine working in this manner will have the same efficiency as a Carnot engine working through the same temperature range, and no engine can have a higher efficiency.

The regenerative heat cycle was invented by Stirling in 1827, only three years after Carnot had published his famous "Reflections on the Motive Power of Heat." That Stirling had ever heard of Carnot's work is very improbable, and it is equally unlikely that he understood fully the theoretical significance of his own invention, for it was made in the days when "caloric" was a material substance and sixteen years before Joule commenced the experiments which demonstrated the true nature of heat. However this may be, he must be given the credit for discovering and applying in practice the only type of thermodynamic cycle, other than that of Carnot, which enables the maximum power to be produced from a given quantity of heat. A considerable number of Stirling engines were built and the reversible regenerative cycle was adopted in some form or another by several subsequent inventors, notably by Ericsson, who substituted regeneration at constant pressure for the regeneration at constant volume adopted by Stirling. Some really good thermal efficiencies, based on indicated horse-power, were obtained, but the engines were bulky and mechanically inefficient. In all of them air was used as the working substance, and the difficulty of getting the heat into it from the furnace was no doubt the principal cause for the disappearance of the type. At any rate, it soon became utterly extinct, so far as practical prime movers are concerned, and few engineers of the present generation can ever have seen a working example. The improvement of the internal combustion engine put the final nail in its coffin. The failure of the regenerative heat cycle to hold its own with air as the working substance and ordinary cast iron as the best available material for the walls of the heating chamber is not surprising. But the inherent merits of the cycle as regards efficiency remain unchanged. They are in no way bound up with the employment of air to work the engine, but are theoretically obtainable equally with any kind of gas or liquid, or even solid, which changes its volume with pressure and temperature. Furthermore, a theoretical efficiency equal to that of the Carnot engine is becoming more than ever an object to be aimed at, for the ordinary steam cycle is receding further and further from this ideal as higher superheats are being adopted. A turbine, for example, working with steam at 500 lb. pressure and 800 deg. Fah. temperature on the ordinary Rankine cycle will have a higher absolute efficiency than an equally perfect machine working with steam at 500 lb. and only 700 deg. Fah., the same vacuum being assumed in both cases. If, however, the performances of the two machines are compared with those of a Carnot engine working through the respective temperature ranges, it will be readily seen that the greater temperature range is not so efficiently utilised. This is a defect inherent in the Rankine cycle, and it cannot be got over so long as that cycle is adhered to. With a regenerative cycle of the Stirling kind the Carnot efficiency would be equally approached in the two cases and, if not actually attained, by reason of the imperfections of the turbine, it would at least be in the bounds of theoretical possibility. These considerations justify a renewed interest in the cycle.

This interest is likely to be awakened by the very novel heat engine described recently by Mr. J. F. J. Malone before the Royal Society of Arts. The Malone engine works on a regenerative cycle, much like that of Stirling, but employs liquid water instead of air. Water at high temperatures is reasonably elastic, as will be understood from the fact that at its critical temperature of 374 deg. Cent. it becomes indistinguishable from steam at a pressure of 3158 lb. per square inch. The cool end of the regenerator being nearest the engine, the water in the latter is never at any high temperature, though its working pressure varies from 1·4 to 5·3 tons during the cycle. Three engines have been constructed, the latest developing 50 horse-power and giving an indicated efficiency of 27 per cent., as shown by independent tests. That mechanical troubles due to the high pressures are not serious is proved by the fact that the second engine built has already run for more than 30 million revolutions under load, a duty equivalent to something like a year's work at twelve hours per day. The inventor believes, and appears to have justification for his belief, that engines of 100 H.P. and over could be built to give an overall efficiency from coal to brake horse-power of 20 per cent., for a weight of 330 lb. per horse-power. Since the Malone engine can be controlled in speed and reversed with perfect ease, its very high fuel economy is expected to make it particularly suitable for marine and locomotive work and also for heavy road vehicles. The rejection of heat at the lower temperature of the cycle, which is thermodynamically necessary, involves the provision of a cooling fluid, such as water or air, in sufficient quantity, but against this there is the advantage that the engine has no exhaust, no drains and needs no supply of feed water. Two speakers in the discussion, including Mr. Llewelyn B. Atkinson, the chairman of the meeting, testified from personal observation to the silence, flexibility, and coolness of the engines when running.

Whatever may be the commercial future of the type, Mr. Malone deserves congratulations on the boldness of his conception no less than on the perseverance with which he has developed it to a practical form. The regenerative heat cycle holds out, as we have shown, extraordinary possibilities of economy. It is good that someone has had the ingenuity to devise and the courage to build an engine designed to take advantage of these possibilities. It is also heartening, in these days of so much ineffective "research work," to come across an instance of the kind of pioneering which has produced all our great mechanical inventions, namely, the construction of something novel, and its perfecting by the light of experience. With the continually improved materials and machining methods now at our disposal there must be many forgotten ideas which would pay for re-examination. To make them work would often call for inventive faculties of a higher order than are required for devising the minor mechanical improvements which fill the records of the Patent Office and the rewards would be proportionately greater.

The Value of Scientific and Technological History.

No. I.

THROUGHOUT this week there is being held in London the Second International Congress of the History of Science and Technology, attended by representatives of many countries, anxious that proper use should be made of the lessons to be learned from a study of scientific and technological history in aiding the world's development. It was opened on Monday, June 29th, by the Right Hon. H. B. Lees-Smith, the President of the Board of Education, in the Great Hall of the Royal Geographical Society at Kensington Gore, London. The President of the Congress is Dr. Charles Singer. The discussions are being held at the Science Museum, South Kensington.

The Congress is a comparatively recent innovation. It originated with the Comité International d'Histoire des Sciences, which was founded at Oslo in 1928. This body meets annually in Paris and organises every three years a congress in which persons interested in the history of science and technology are invited to take part. (The first Congress was held in Sweden.) For the present Congress the Comité has the co-operation of its parent body, the Comité International d'Histoire des Sciences, together with that of two other international societies—the History of Science Society, Washington, D.C., and the Newcomen Society for the Study of the History of Engineering and Technology, London. Mr. H. W. Dickinson, the Hon. Secretary of the Newcomen Society, is also the Hon. Secretary of the Congress.

The list of officers and members of Committees includes the names of many who are distinguished in scientific and technological circles in this country. Sir William Bragg, O.M., K.B.E., F.R.S., the Director of the Royal Institution of Great Britain, is Hon. Treasurer; and the Executive Committee consists of Professor C. H. Desch, F.R.S., University of Sheffield; Sir Walter M. Fletcher, K.B.E., C.B., F.R.S., Medical Research Council; Dr. K. J. Franklin, Oriel College, Oxford; Sir Richard Gregory, Bart., Editor of *Nature*; Dr. E. J. Holmyard, Clifton College, Bristol; Sir Frederic G. Kenyon, C.B.E., K.C.B., F.B.A.; Colonel Sir Henry Lyons, F.R.S., Director, Science Museum; Dr. Joseph Needham, Cambridge; Mr. Guy Parsloe, Secretary, Institute of Historical Research; Mrs. Dorothea Waley Singer, and Mrs. T. F. Tout.

Official representatives are attending the Congress from Australia, Belgium, Canada, China, Czecho-Slovakia, Egypt, France, Great Britain, Guatemala, Germany, Holland, Honduras, Hungary, India, Ireland, Japan, Morocco, Norway, Paraguay, Poland, South Africa, Switzerland, the Union of Soviet Socialist Republics, and the United States of America. The Russian delegation is quite a strong one, and it is understood that at the end of the week these delegates will read papers on the Marxian view of the history of science.

In addition to the formal discussions, arrangements have been made for a series of visits to places of interest, and there are various social functions. There are visits to Oxford and Cambridge, where the attractions include the exhibition of books and manuscripts. Other places to be visited are the Science Museum, South Kensington; the British Museum, Bloomsbury; the Royal Society; the Barber-Surgeons' Hall, which was built by Inigo Jones, and escaped the Fire of London in 1666; the Natural History Museum; Greenwich Observatory; the University of London Institute of Historical Research; and Down House, Kent, which was the home of Charles Darwin for forty years, and was presented by Mr. G. Buckstone Browne, F.R.C.S., to the British Association for the Advancement of Science as a permanent memorial to Darwin.

The President of the Board of Education, in opening the Congress, said it was a commonplace that the greatest events in history took place in the realm of

ideas, and the Congress had been formed because thinkers were beginning to realise that ideas which emerged and developed in the minds of men of science and technology moulded the destinies of mankind. It was in accordance with the spirit of the times that teachers had realised that the history of the great creative forces which science had set in motion should be studied side by side with the history of other aspects of civilisation, which they were beginning to suspect were less important than those hitherto ignored.

To illustrate the rapidity with which the achievements of science and technology were progressing, he mentioned the far-reaching advances which had been made even during the eighteen months in which he had held the office of Postmaster-General. They included the inauguration of the public service for the transmission of pictures by telegraph and wireless telephony with ships at sea and with Australia. But, he asked, was the moral progress of mankind keeping pace with man's material advancement? Everyone accepted progress in science and invention, but the public was more unwilling to accept the responsibility of a correspondingly progressive morality. The supreme question which now rested between nations was whether these great conquests of Nature achieved by science were to be used for the enlargement and enrichment of life or for the destruction of our fellowmen. If ever again they were utilised on a large scale for purposes of destruction, Western civilisation would disappear—and rightly so—because it would have failed to answer the great moral tests by which in the last resort any civilisation must be judged.

Dr. Singer, in his presidential address, urged that the teaching of history was too little occupied with the affairs of the mind. The rise of science was the most important event in human history since the fall of the Roman Empire, but none of the text-books of history said so. Judging by the history book used by his own daughter, the critical years which saw the foundation of the Royal Society, the publication of Robert Hooke's "Micrographia," Newton's work on prisms and his great "Principia," were apparently occupied exclusively by battles.

The main theme of the address was that of the beginnings of science. Without attempting a definition, he said, science might be regarded as the systematic process of recording natural events with the object of discerning relationship between them. Science was often regarded as a static body of knowledge, rather than a continuous process. Yet science which ceased to develop soon ceased to be science. Systems blindly accepted would soon be misunderstood. Such discarded outgrowths of earlier scientific hypotheses as the theories of judicial astrology or the doctrine of cataclysms reminded us that all scientific views, including those of our own time, were but a stage in a great secular process.

The earliest surviving complete scientific treatises were medical, and in Greek. They bore the name of Hippocrates, though they were certainly not by him; certain of them were of the fifth or even the sixth century B.C. The Greeks commonly held that their science came from Egypt. Until recently, papyrus finds had been disappointing in this matter, but two papyri recently published threw light on early science, and they suggested a hitherto unrecognised scientific interest in ancient Egypt. One was the Edwin Smith surgical papyrus of the sixteenth century B.C. It was discovered seventy years ago, but remained unnoticed in a private library until edited by Professor Breasted, of Chicago. Parts of it could reasonably be called scientific. The Moscow mathematical papyrus, of about the same age, had been published at Berlin by Professor Struve. It gave rules for finding areas of figures enclosed by straight lines, and other important propositions. The circumference of a circle was given as 3·16 times the diameter, which compared favourably with the approximate 3·1416 of modern usage. The claim of the Greeks themselves, that much of their science was of Egyptian origin, thus became more probable than it seemed to be only a few years ago.

After a reception by Dr. and Mrs. Singer at the Royal Society of Medicine on Monday evening, June 29th, Mr. G. H. Gabb's collection of relics, instruments, portraits, and medals relating to Joseph Priestley, F.R.S. (1733–1804), was exhibited; Dr. Reginald S. Clay exhibited items from his collection of historical optical instruments; and Professor E. N. da C. Andrade, wearing eighteenth century dress, lectured "On Some Surprising Phenomena Touching Light and Electricity," impersonating Francis Hauksbee, F.R.S., one of the pioneers of the study of electricity, and the first to build an electrical machine and to obtain electrical discharges in evacuated tubes. Professor Andrade made experiments known to have been carried out by Hauksbee about 1703.

SCIENCE AND HISTORY.

The Sciences as an Integral Part of General Historical Study was the subject of the first session on Tuesday, June 30th, at the Science Museum, under the chairmanship of Professor Gino Loria, of the University of Genoa and a Vice-President of the Congress. The session was opened by Professor G. N. Clark, of Oriel College, Oxford, whose studies are concerned mainly with international relations in the economic and political spheres, but, he said, although he had originally approached these from a very different point of view, he had been led in more ways than one to regard the history of science as closely and necessarily connected with them. On the one hand, the history of technology must be studied if war, industry, and transport were to be understood; and, on the other hand, the governing ideas in social organisation, in politics and philosophy, could not be studied in isolation from the ideas of science. When contrasted with the history of other departments of thought, and still more when contrasted with economic or political history, the history of science seemed to be distinguished by more definite achievements, a clearer articulation, a more orderly development. Science might be said to have more truly a history than had other human activities, and this had led to interpretations of general history in which the history of science occupied the central place. Commenting on the development of technology, he mentioned the occasion on which King Charles II. had complained that the members of the Royal Society were wasting time by making experiments on the weighing of air. These preliminaries, however, were followed by the invention of the steam engine—the most remarkable advance in technology in recent history—and the extraordinary stupidity of Charles in thinking that these experiments were entirely distinct from technology was an indication of an attitude which it was hoped was rapidly perishing.

The place of the history of science in general history, he said, was neither that of a detachable unit in an unorganised aggregate nor that of an independent agent which was not itself acted upon, but that of a living member in an organic whole.

Another speaker in this discussion was Sir William Dampier-Whetham, F.R.S., of Trinity College, Cambridge, who urged that it was want of appreciation of values which allowed no place in the usual curriculum of our schools of history and literature, indeed of science itself, for the history of science. What could more clearly enable the student of science to realise the strength and the weakness, the real essence and value, of his studies, than the history of their development and of their interaction with economics, with philosophy, and with religion? For such reasons, Sir William claimed a place for this most noble subject in our schools of history, of literature, and of science.

Among other speakers who claimed that the sciences up to the present did not form an integral part of general historical study, and who pleaded that the developments of science should be given a more prominent place in our standard histories, was Dr. E. J. Holmyard, of Clifton College, Bristol. The standard histories of the world, he said, faithfully reflected the attitude of the great majority of professional historians in the meagre space they allowed to the development of science, and in their almost complete failure to understand the part that scientific knowledge had played in the growth of civilisation. The Cambridge Modern History, for example, devoted some fifty pages, out of twelve large volumes, to the history of scientific thought; moreover, the subject was treated in such a way that it virtually formed an appendix rather than an integral part of the theme. Dalton's atomic theory and Lavoisier's theory of combustion—upon which, it was hardly an exaggeration to say, modern civilisation ultimately rested—were dismissed in less than three pages, and even these were not without error. Only those who had experienced the discipline of science could estimate its real worth. It was just that searching intellectual activity, the calm and impartial exercise of the unclouded reason, and the fearless employment of the human imagination that would form an irresistible magnet to the humanist if he could be made to feel it. He did not see how this magnet could be brought into action for those who were not students of science, except by urging the inclusion of the history of science in the literary courses at schools, colleges, and universities. Even this, by itself, would not be quite sufficient. There still lingered in scholarly circles the old Greek idea that any subject which required manipulation of material was, *ipso facto*, of a somewhat undignified nature. Therefore, courses in the history of science should invariably include some work in the laboratory; it need not be much, but it should never be omitted, and though it should be simple in character, it should be executed with the greatest possible care, and the highest standard of accuracy ought to be insisted upon. Dr. Holmyard described how these ideas had been put into practice at Clifton College in the training of some of the senior classical historical and modern language boys. For three hours each week they came into the science school, and approximately half that time was spent in laboratory work. Sometimes the course was arranged on the history of science in general; in other years they studied a particular science or even a branch of a science. In the present academic year his class of literary students had been studying organic chemistry, and had reached a satisfactory level in both the theory and the practice. They had begun to realise the objects and methods of the chemist. They appreciated the way in which scientific achievement might affect the commerce of the world and the daily lives of people very far remote from one another—as the peasants in India and the artisans in Manchester or Mannheim.

Mr. Thomas Greenwood, M.A., of Birkbeck College, London, maintained that in the study of scientific history mathematics should be included, though it was wrongly regarded by some as the most autonomous of all human activities. If, he said, one admitted the obvious influence of philosophy on the moral and social actions of men, and of technology on the material and political actions of men, surely by reflecting upon the continuous succession of dovetailed causes one would find that mathematics was a necessary constituent element of both philosophy and technology.

A representative from Russia then joined in the discussion. He was Professor M. Rubinstein, of the Institute of Economics, Moscow, and he stated it to be impossible to understand anything in the development, either of the history of humanity or of the history of science and technique, if they were studied without a scientific analysis of the rise and decay of the capitalist social system, the scientific analysis of which was begun by the work of Karl Marx. The purpose and motive force of the capitalist system of production lay in profit. And this same motive force had underlain both the wars and battles of the past and the development of science and technique. History had been made, not by the Napoleons and Nelsons, not by Foch or Hindenburg, not, unfortunately, by the Darwins or Maxwells, but by those economic and social forces of which all these and other great men—or supposedly great men—had been the expression. He went on to talk of scientific and technical discovery under the conditions of the capitalist system having led to the ruination of millions of petty artisans and peasants, and to unemployment and exploitation, and of the terrible world crisis of capitalism having become the greatest obstacle to the development of science and technique. Only the analysis of the rise and decay of the social system made it possible to draw practical conclusions from historical investigation, *i.e.*, as Marx had said, not only to explain the world, but also to proceed to change it. Those in the Soviet Union believed they had begun this gigantic task.

THE HISTORY OF SCIENCE.

The Teaching of the History of Science was the subject of another discussion on Tuesday morning, under the chairmanship of Dr. W. H. Welch, of the John Hopkins University.

One of the speakers in this discussion, Professor A. Wolf, of University College, London, sketched the story of the introduction of the history of science into the curriculum in London and indicated some of the problems in connection with it. He recalled that in 1919 the University had instituted a Diploma in Journalism, and a general, elementary course on the history of science was given, in the session 1919–20, for the benefit of those candidates who proposed to specialise in scientific and technological journalism. At that time he was in the Department of Philosophy, but had made a study of the history of science, with special reference to its methods and principles. In 1920–21 additional courses were given on the histories of astronomy, biology and mathematics respectively. In 1921 a special department of the history and methods of science was created at University College and entrusted to his care. The number of courses was increased considerably. In 1922 the University instituted a special Board of Studies for the history of science, and Professor Whitehead was its first chairman. Thanks to the endeavours of this Board, the history, methods and principles of science could be taken for the M.Sc. degree after 1924. In a reference to some of the difficulties, Professor Wolf mentioned that there was great difficulty in getting things published, and that there was a certain amount of hostility to new subjects, and many of those who influenced the purse-strings foolishly imagined that studies of this kind could be treated as a side-line to something else.

A plea for weeding out unnecessary things in education was made by Professor David Eugene Smith, of Columbia University, New York State. He referred to activities there with regard to mathematics, and to a general survey course, one of the objects of which was to enable men to appreciate what elements were useful and which were not. Unless a teacher could give a reason, based on present needs, as to why he was teaching anything, it should go by the board. They did not care who invented the plus sign; the point was how did it get there, and did it still have a significance; if not, then change it. In mathematics, he said, there had been a tremendous accumulation of the obsolete, and the same was true of medicine and the law. Whilst admiring the thoroughness of those of the Old World, he told them that they had more barnacles on the mathematical ship than had those in the New World; he urged that these barnacles should be taken off, so that the ship could make better progress.

There was a reception on the evening of Tuesday, June 30th, by the President and Managers of the Royal Institution of Great Britain, at the Royal Institution, 21, Albemarle-street, London. Sir William Bragg, O.M., F.R.S., discussed some classical experiments of the Royal Institution, and gave experimental illustrations. The historical apparatus of Rumford, Davy, Faraday, Tyndall, Rayleigh, Dewar and others, in the possession of the Institution, were on view.

The whole of Wednesday, July 1st, was occupied by a visit to Cambridge.

(To be continued.)

Obituary.

SIR HUGH BELL.

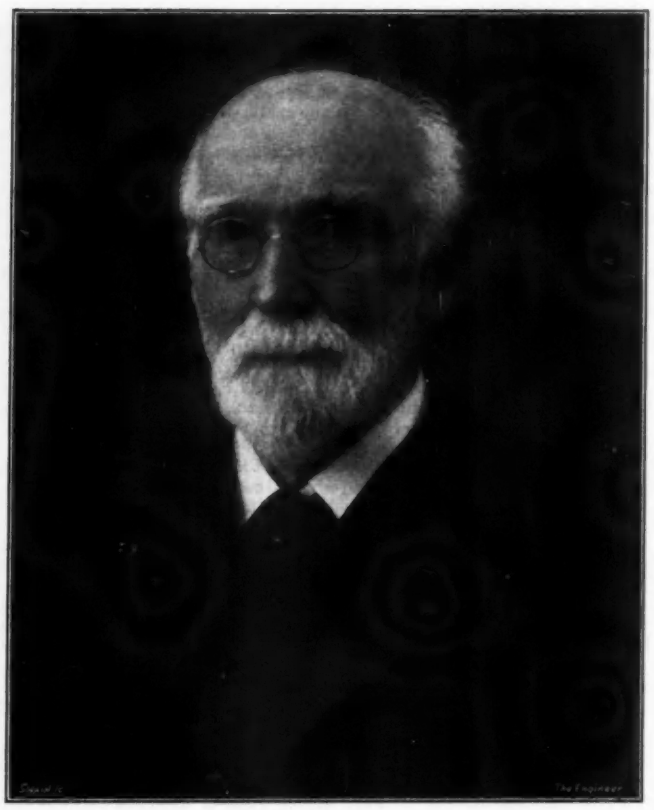
THE death of Sir Hugh Bell, which took place at his London residence, 95, Sloane-street, S.W. 1, as the result of an illness of a few days' duration only, in the early hours of Monday last, June 29th, severs one of the few remaining links which still connect the present times with the earlier years of the reign of Queen Victoria, and removes from the scene of many years of strenuous activities a picturesque and forceful personality which will be greatly missed in many departments of the social, business, and technical world. Sir Hugh's span of life—he was eighty-seven at the time of his death—was contemporaneous with the rise and progress of modern industrialism, and in particular with that of the iron and steel trades, and of the chemical industries, in the development of which both he and his father before him played intimate and conspicuously successful parts.

Thomas Hugh Bell was born at Walker-on-Tyne on February 10th, 1844. He was the elder son of Sir Isaac Lowthian Bell, and a grandson of Thomas Bell, of Lowhurst, Cumberland, who had previously left the western county of his birth and settled at Gateshead. Here, in 1807, Thomas Bell entered the firm of Losh and Co., chemical manufacturers, which eventually became the firm of Losh, Wilson and Bell, and was instrumental in introducing into this country the Leblanc soda process. Isaac Lowthian Bell married in 1842 a daughter of Hugh Lee Pattinson, the well-known chemist, and in 1850 entered into partnership with his father-in-law and established another chemical works at Washington, where, in 1860, the first aluminium ever produced on a commercial scale in this country was manufactured by the St. Claire Deville process. Sir Lowthian—as he later became—was a genius. He was also a man of strong personality and restless energy. By 1866 he had added to the Washington works a blast-furnace, and amongst other technical improvements utilised the exhaust steam from the blowing engines to heat the water required in the process of lead extraction and desilverisation with which the name of his father-in-law, Hugh Pattinson, is associated.

It was in an atmosphere, therefore, of scientific and technical enterprise, pursued both by his father and his grandfather with great business ability, that Hugh Bell was brought up. The training and methods which his paternal grandfather had applied to his son, Isaac Lowthian, were applied in turn by the latter to his own two sons, Hugh and Charles. Lowthian Bell had been educated privately at Newcastle, and subsequently at Edinburgh University, at the Sorbonne in Paris, in Germany, and even in Denmark. The sons were to follow a very similar course. Hugh's education commenced at a private school not far from his home, and was continued at Murchiston House School, Edinburgh. At the age of fifteen he was sent to Paris to study, and attended classes held at the Sorbonne by Deville, and later he went to Göttingen, where he continued his studies under Friedrich Wöhler and Stein. It was during his residence abroad that he acquired that admirable fluency of expression, both in French and in German, which he exhibited so often in after life, in speeches in both languages. His brother Charles had to serve a somewhat similar apprenticeship, only the nature of his training was slightly different. Hugh Bell's education included science, but leaned more towards the business side, in order the better to fit him for the administrational duties he was destined to fulfil. Charles Bell was educated at Wellington, at the School of Mines, Paris, and at a technical institute in Germany. He was to be the technical man; Hugh, his brother, the business man. Charles managed the works of Bell Brothers at Middlesbrough, with marked success for many years, but he died in 1906 at the comparatively early age of fifty-one, and bequeathed most of his large interests to his elder brother. Mention of the works at Middlesbrough is, however, somewhat to anticipate the sequence of events which went to the shaping of that brother's career.

Hugh Bell—as he preferred to be called—had to work hard in his youth and early manhood; it was a family tradition and he made it his own. He began his business career at eighteen, and tirelessly pursued it for nearly seventy years. He had a mind which assimilated knowledge readily, and a retentive memory. Until the time when his father, who received a baronetcy in 1895, died, in 1904, until, that is, Hugh Bell had reached late middle life, his career was overshadowed somewhat by that of his father. During his long business apprenticeship he had, however, filled several directorates, and had occupied administrative and responsible posts with conspicuous ability and had impressed all with whom he came in contact with a sense of his great abilities and extraordinary grasp of detail. But if, from a business point of view, Hugh Bell, during Sir Lowthian Bell's lifetime, occupied a position secondary in importance to that of his distinguished father, his social life and other activities comprised many interests and made many contacts. He served as alderman for many years on the North Riding County Council, and as High Sheriff of the County of Durham. He was three times Mayor of Middlesbrough. Like his father, who sat in Parliament for five years, he aspired to a seat in the House, and contested Middlesbrough in the Conservative interest in 1892, but was defeated. He was a life-long and militant Free Trader, and severed his connection with the Conservative Party soon after the Tariff reform movement of the early years of the present century was inaugurated by Mr. Joseph Chamberlain. Later on, being an equally convinced and militant Unionist, he severed the official connection he had formed with the Liberal Party in which interest he had fought, as a Liberal Free Trader, the historic election for the City of London, on the occasion in 1910 when Balfour, defeated at East Manchester, was elected by a huge majority, to represent the Metropolis. Of late years Sir Hugh Bell had been Chairman of the Cobden Club. In 1906 he was created Lord Lieutenant of the North Riding of Yorkshire, and he was also Deputy Lieutenant of the County of Durham. He received, *honoris causa*, degrees in Laws from the Universities of Oxford, Leeds, Sheffield, and Durham, and was on the Senate of the latter University, while for many years he was Chairman of Council of Armstrong College, Newcastle. He was also on the Board of the Imperial College of Science and Technology, and had served on that of the National Physical Laboratory. In 1918 he had conferred upon him, in recognition of distinguished civilian services during the war, the Companionship of the Bath. His wife, Lady Florence Bell, was a Dame of the Order of the British Empire.

It was, however, in connection with the iron and steel industries and the great chemical enterprises with which Sir Hugh Bell was associated that his influence and his abilities were chiefly exercised. The story of the opening up of the Cleveland iron ore deposits and of the subsequent rapid growth of the town of Middlesbrough and the surrounding neighbourhood has been told over and over again. It will suffice here to recall that as far back as 1844, and conjointly with the prosecution of his numerous other interests, Isaac Lowthian Bell and his two brothers, Thomas and John, had established the firm of Bell Brothers, had leased a blast-furnace at Wylam-on-Tyne, and had commenced to experiment with charges of the local Cleveland ores. Ten years later they founded the Clarence Works at Middlesbrough, deriving their ore supplies from Normanby. A sharp tussle ensued with the rival firm of Bolckow, Vaughan and Co., which took the form of a struggle for the possession of the means of access to the ore-fields, which the latter sought to monopolise. This led at first to the promotion of rival railway lines, but eventually to compromise and agreement. Secure in the possession of iron ore mines, collieries, limestone quarries, and means of transport, the firm of Bell Brothers started to make not only pig iron, but steel as well, and eventually having amalgamated with the firm of Dorman Long and Co., a great new steel works was built by the conjoint interests at Port Clarence. In all the pioneer work and the negotiations involved in the establishment of these new industries and their subsequent development, Sir Hugh Bell played a leading part, and it was the Bell wealth which rendered the enterprise possible. At the time of his father's death, Sir Hugh became chairman of Bell Brothers, and in all further transformations and combinations of the various interests involved he retained a seat on the board and took an active part in the developments. He was also a director of Brunner, Mond and Co., Ltd., which had acquired from the firm of Bell Brothers the works they had established in Middlesbrough for the manufacture of soda.



SIR HUGH BELL, BART.

From the time of his succession to the baronetcy in 1904, Sir Hugh Bell took and maintained a prominent position in the iron, steel, and coal industries of the country, and in the various associations, commercial and technical, devoted to their advancement. Almost his earliest public appearance in these capacities was as President of the Iron and Steel Institute, which he was invited to become in 1907. The scholarly nature of the Presidential Address which he delivered on that occasion received instant recognition and appreciation. To the "Proceedings" of that Institute he contributed several papers of a high antiquarian interest, while he devoted much of his time to the work of the Institute itself and attended constantly its Council and Committee meetings. Both as a writer and as a speaker, he was indeed singularly gifted. He possessed a delicate, if at times trenchant, wit, and was himself an exponent of the sturdy individualism which he at all times advocated. He made at the Spring Meeting of the Institute of Metals as recently as last March a typically delightful speech, in which he once again made a declaration of his life-long principles which comprised an abounding faith in Free Trade and an intense dislike of Government interference in industrial matters. He was, indeed, always innately intolerant of opposition, and skilled in subduing or countering it, and while to those whom he liked he was a warm friend and a steady and generous supporter, he was apt to conceive and cherish deep antipathies which he seldom, if ever, abandoned. His energy was boundless and his capacity for taking pains amounted to genius.

Amongst his manifold business activities, Sir Hugh Bell was chairman of Horden Collieries, Ltd., of Pearson and Dorman, Ltd., and of the Channel Steel Company, Ltd. He was a director of Dorman, Long and Co., Ltd., of the Forth Bridge Railway Company, of Great Eastern Train Ferries, Ltd., and of the London and North-Eastern Railway, of which he had likewise been chairman. He was also a director of the Wilsons and North-Eastern Shipping Company, and of the Yorkshire Insurance Company, Ltd. He was an active member of the governing body of the National Federation of Iron and Steel Manufacturers and Chairman of its Statistical Committee. He was twice married. His first wife, Mary, the daughter of the late John Sheild, of Newcastle, to whom he was married in 1867, bore him two children, Gertrude Lowthian Bell, the distinguished Persian scholar and Oriental Secretary to the High Commissioner for Iraq, who died in 1926, and Lieut.-Colonel Maurice Hugh Lowthian Bell, C.M.G., who succeeds to the baronetcy. His second wife was Florence, the daughter of the late Sir Joseph Olliffe, M.D. She was a woman of brilliant attainments, whose death, after a married life of over fifty-four years, affected him profoundly.

Trade and Foreign Colonies.

(By our own Correspondent in Paris.)

No. I.

AMONGST the changing conditions that are affecting the trade future, one of far-reaching importance is the development of foreign colonies. The belief abroad that colonies are necessary to ensure an economic independence has been growing for many years, and that idea has crystallised in the International Colonial Exhibition in Paris, in which, for the first time, all the colonial Powers are participating. The value of colonies is always economical, and often political, and the commercial value of new territories lies in the supply of products and raw material to the countries owning them. The immediate aim of foreign Powers is to free themselves from outside sources of raw material by obtaining as much as they possibly can from their own colonies. This means that new channels of supply are created, to the detriment of those existing. The colonies will furnish much of what is now being obtained from all over the world, and largely from British Dominions, and carried, for the most part, on British bottoms. Practically all the colonial produce of other countries is carried on ships of their respective nationalities. Colonial development necessarily means a development of national shipping. There is, of course, a limit to foreign colonial expansion, because there is little new territory available for colonising purposes, and the work now being undertaken to open up fresh supplies of raw material cannot be carried on indefinitely. Still, there are vast resources in Africa that are being and will be developed to an extent that must change the outlook for the future. It cannot be affirmed that there is a danger of excessive overproduction, because new foreign colonial enterprise cannot produce adequate results for many years to come, by which time it is probable that the present disparity between supply and demand will be adjusted. If, moreover, the development is followed by a large colonial demand for manufactured goods, it will contribute to the general prosperity. At the Exhibition, Belgium and Holland are the leading colonial Powers, besides France, which provide full and instructive data, the one in a Congo pavilion and the other in the reproduction of a Buddhist temple.* The participation of Great Britain is limited to a remarkably detailed survey of what has been done to stamp out epidemics and diseases amongst native populations. This offers a striking example of British civilising influence, and is more impressive and more instructive to those engaged abroad in dealing with similar colonial problems than any spectacular display of material progress. South Africa and Canada have small exhibits, and there are pavilions for Palestine and India.

THE BELGIAN CONGO.

The Belgian Congo is being developed in a way and on a scale that have probably never before been attempted in the case of an entirely new territory. It is a financial enterprise run by the State and the two leading banks—the Société Générale de Belgique and the Banque de Bruxelles—with subsidiary banks in the Congo itself. All the agricultural, mining, industrial and other work is carried out by big companies financed by the banks. Since the creation of the colony the capital invested in it has reached the total of 1600 million gold francs. The annual investment was rising rapidly until 1929, but last year it fell to the level of five years ago. The Belgian Congo is eighty times larger than Belgium itself, and the population is estimated at 10 millions, which represents a density of approximately four inhabitants to the square kilometre. The white population is less than 30,000. The investment of so much capital is regarded as fully justified by the extraordinary wealth which has only of late years begun to be taken out of the colony. The country is covered for the most part by forests, leaving vast well-watered spaces which are being used for the raising of cattle and sheep and for the production of tea, coffee, cocoa, cotton, palm nuts, sugar cane, and practically everything else required at home. The Belgians can well believe that the colony will supply them with all the produce and raw material they need. To the south-east of the Congo, and adjoining Northern Rhodesia, is the province of Katanga, which may be counted amongst the richest mineral-bearing regions in the world. Practically the whole of the mining enterprise is in the hands of the Union Minière du Haut-Katanga, which is working seven copper mines, an iron ore mine, two tin mines, and a number of quarries. It is estimated that the deposits already prospected contain 5,000,000 tons of copper. Last year they produced 140,000 tons of the metal, most of which went to Mozambique and the Tanganyika Territory. The copper mines started working ten years ago and the production has been rapidly increasing. The company has also uranium ore from which radium is obtained in quantities that have increased from 20 grammes in 1923 to 60 grammes in 1929. In that year, also, 708 tons of metallic cobalt were produced. The Société des Mines de Kilo-Moto mined 6000 kilos. of gold last year in a region to the north-east of the province, and a fair quantity of diamonds is obtained, mainly of a quality for industrial uses. This outline is sufficient to indicate the variety and value of the Congo products and the possibilities of commercial and industrial achievement when the work of equipping the colony is more advanced.

Trade with the Belgian Congo has tripled in ten years, and the imports into the colony have consisted largely of manufactured goods, machinery and plant and everything necessary for the general equipment. There are sugar and palm oil factories and cotton-growing is an important industry, the quality of the cotton being said to be superior to that obtained from the usual sources, and in 1929 more than 9000 tons of Congo cotton were supplied to Belgian spinners. All this agricultural, plantation and mining activity has to be carried on with the least possible native labour, chiefly because such labour has to be recruited from long distances and it is never efficient. Therefore, the best labour-saving machinery has to be employed, and all transport is effected by motor cars and lorries, so that the conditions in the colony are favourable to rational and growing exchanges. The Congo is, no doubt, suffering from the depreciation of values, like all other producers of raw material, and the fall in investments last year may indicate a check in the progress which had been remarkably constant for the preceding ten years, but there is, nevertheless, no apparent limit to the purchases of machinery and plant so long as the raw material supplied can go into consumption. The mining and other companies are making full use of hydraulic power. Existing installations are supplying 64,800 horse-power, and others under construction will provide 30,600 horse-power. The railways will probably be at least partially electrified by this means.

The Belgian Congo is a free market, and Belgian manufacturers do not enjoy any preferential fiscal treatment; but they get a larger share of the trade on account of the preference shown by the Belgian companies which buy the goods. So far as mechanical products are concerned, Belgian firms do probably rather more than one-half of the trade, the remainder going to a number of countries, amongst which Great Britain is low on the list. This is all the more regrettable, because the Belgian Congo is becoming a centre of distribution. It already supplies goods to French Equatorial Africa, Tanganyika Territory and Northern Rhodesia, and when the section of the railway is completed between Leopoldville and Fort Francqui there will be direct railway communication between the port of Matadi at the mouth of the Congo and the Cape. The fact that nearly one-half of the mechanical goods imported into the Belgian Congo come from countries other than Belgium makes it sufficiently clear that British makers are on the same level as their foreign competitors, and that if they can supply what is needed under equal conditions they should secure a fair share of the business. There is much to be done by makers who specialise in colonial machinery. To give an example, a type of small machine for the extraction of palm oil is needed to replace the inefficient methods the natives now employ. The companies obtain all the oil they can from natives, and they are anxious to introduce anything which will increase and cheapen supplies.

The Belgian pavilion is made interesting and instructive with dioramas of towns and ports, models of mines and quarries, and a complete collection of documents, maps and statistical diagrams, which give a clear idea of what is being accomplished in the colony. The Union Minière du Haut-Katanga seeks a new field for the consumption of copper by exhibiting houses built of that metal. As soon as the company begins to develop fully its immense resources it will need to extend the consumption, and if copper can be employed for the construction of houses there will be less fear of a glut of the metal. The walls are built of two layers of sheet copper, stamped externally with rectangular designs and internally with artistic patterns with an enamel finish. Between them there is an insulating layer of asbestos and air. The houses are supplied in sections ready for erection without the aid of skilled labour. A number of advantages are claimed for the copper construction, which is declared to be economical as compared with bricks, and is obviously durable, and it is affirmed that copper dwellings undergo no depreciation.

(To be continued.)

* Completely destroyed by fire on Sunday night, June 28th.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

PROBLEMS OF ELECTRICITY SUPPLY.

SIR,—I am sure that all well-wishers of the general engineering trades of this country are thankful for your very interesting and illuminating leading article which appeared in THE ENGINEER on the 26th inst. The references to the remarks made by various well-known electrical energy supply authorities all point to the fact that, gradually, the truth is coming out, and that the financial success of the—so-called—"Grid" is somewhat doubtful. Surely it is time to call a halt to these "political" experiments, as they cannot be termed matters of material advantage to the "technical" development of the industries of this country.

Indeed, when one considers the disorganisation and general state of uncertainty which this, supposed to be, supply of "cheap" and "abundant" electrical energy has brought about, it is, indeed, wonderful that even the general public have tolerated it so far, and it certainly does not speak much for the English engineering trades that they have not been much more critical of these quite artful manœuvres. The suggestion made by the President of the Incorporated Municipal Electrical Association is surely very strange. Why, indeed, should the towns have inflicted on them the quite unnecessary cost of providing the transmission lines, for the use of long-distance and much smaller consumers, who, generally, can make their own electrical, or other, power on their own premises so very much cheaper than it can be "commercially" supplied from any electrical power supply organisation, as it is very well known that the great cost of distribution and transmission of electrical energy is generally against its use, with, perhaps, the sole exception, in the case of some isolated waterfall, whose energy it may be rightly proposed to use for industrial purposes? Even in this ideal case it is not always a strictly speaking "commercial" thing to bring about, because it is well known that, owing to the great improvements brought about during the last decade in all kinds of heat engines, even hydro-electric power is, in the majority of cases, no solution of the cheap industrial power problem.

The time for a regular close investigation into the industrial power problem is, surely, at hand, particularly as it is evident that the present scheme is not going to turn out in the manner it was promised to do. The loading up of the general industries of this country with taxation to cover the expenditure on quite unnecessary political experiments, such as this National Electricity Supply Scheme, and the proposed electrification of the main line railways, or even the suburban railways, is becoming a very serious matter. Surely, it can be safely left to the engineering industry to look after itself, and not be hampered by these political interferences and likely gambles on the public welfare.

There is no question, whatsoever, that any large factory—and this is the day of large factories—can produce its own operating power on a proper businesslike commercial basis much cheaper than it is "commercially" possible to purchase same. Particularly is this so when one considers the very inconvenient speed-power characteristics of the A.C. method, which, for some reason, has been adopted in connection with the national "Grid" supply.

May I make the suggestion that this electrical energy supply should be treated as such, and no more—in a similar manner to that which was proposed in the electrification of railways scheme—and that any factory which chooses to do so can lay on a supply, but it be left to the consumer to use it, "as and when" he chooses, particularly in the remote case of a breakdown with his own oil or gas-engined power plant. Even then it is doubtful if such an external supply would be really required, as any well-designed factory power plant would always embody both oil, or gas, or electrical accumulator storage of energy, which could always meet all such temporary demands for power.

WILLIAM P. DURTNALL.

London, S.E. 5, June 30th.

BASIC BESSEMER STEEL.

SIR,—I have read with interest the article in the issue of THE METALLURGIST for May, entitled "The Cheapest Steel or the Best?" in which reference is made to the paper on the "Basic Bessemer Process" which I read at the May Meeting of the Iron and Steel Institute, and I shall be obliged if you will allow me to reply to some of the points raised.

Whilst I do not hold any brief for the basic Bessemer process, I would like to make the following comments on the article:—

(1) I submit that the paper is distinctly technical in character, dealing as it does with the suitability of our ores for the manufacture of basic Bessemer pig iron. A comparison of operating costs in basic Bessemer plants and a modern open-hearth plant is given, and questions of yield, composition of the metal, and points in connection with general lay-out of the basic Bessemer plant are also discussed. These would appear to be all technical matters, and all fiscal and political issues were carefully avoided in the paper. The object of the paper was to raise the question whether basic Bessemer steel can be produced with our natural resources in this country at as low a cost as on the Continent, and at a lower cost than in the basic open-hearth. It is true that the commercial aspect cannot be entirely separated from the technical when dealing with a subject of this class, but it must be realised that it is only by the close consideration of commercial and metallurgical aspects that any real improvements can be expected in our iron and steel industry.

(2) No suggestion was made that basic Bessemer steel, if manufactured in this country, should be used for any purposes to which even the most critical of engineers could object. Particular stress was laid on the proposed field for this class of steel to which its use should be strictly limited, such as tin-plates, wire rods, and similar classes of low-carbon steel.

(3) Certain classes of articles subjected to no serious stresses always have been and always will be made from the cheapest steel, provided the results are satisfactory. Such being the case, surely it is sound economy to explore all methods for the production of cheap steel for its own particular market.

(4) If it were proved to be economically possible to produce basic Bessemer steel cheaper than basic open-hearth in this country and at a price capable of competing with continental imports, a plant laid out for the mass production of the specified semi-finished products would go a long way to preventing the use of basic Bessemer steel for work for which it is admitted to be unsuitable.

(5) Whilst agreeing that one of our greatest assets in this country is the production of material of the highest quality and that we should continue to lead the world in the production of special steels for particular purposes, I contend that there is a real demand for cheap steel for the purposes mentioned. The highest class of steel is made in the crucible, acid open-hearth, and electric furnaces, using specially selected materials, and if the argument of the writer be carried to its logical conclusion, all steel should be made by these processes and all our basic open-hearth plants should be closed down.

(6) In view of the above points, I consider that the question raised in my paper, Whether or not we can produce basic Bessemer steel in this country as cheaply as it can be produced on the Continent, and cheaper than we can do in basic open-hearth furnaces, is one which is worthy of the fullest investigation. To refuse to investigate the problem on the grounds suggested in the article in THE METALLURGIST would appear to be playing into the hands of our continental competitors.

VERNON HARBORD.

London, S.W. 1, June 29th.

RAIL RATES HANDICAP ON STEEL.

SIR,—The railway rates, or cost of transport, handicap on trade does not seem to be well understood. Take the case of steel. Foreign steel is pouring into this country—even into Sheffield itself—whilst two-thirds of our iron and steel works' capacity is idle. Please note how cost of transport affects the business.

The foreign steel has, first, to bear assemblage costs on its raw materials, mostly for very long hauls, for in many foreign countries the iron ore and the coal mines are far apart, whereas here we have ore and coal near together. Secondly, the foreign steel has to be carried very long journeys from works to ports, for in no country but Britain are steel works to be found near docks. Thirdly, the foreign steel has to carry foreign dock charges. Fourthly, sea freights. Fifthly, British dock charges. Finally, British rail rates from our ports to Sheffield, Birmingham, and other places before it can be marketed in these cities. Obviously the rail rate or transport cost handicap is on the foreign, not the British steel. The foreign steel has to carry vastly higher transport charges than our steel. Here we have the shortest and cheapest rail hauls in the world—the shortest distances between ore and coal, between mines and works, between works and ports or consuming districts. In spite of this fact we are invited to believe that our industry or trade is handicapped by excessive rail rates. It is high time British industrialists dropped delusions and took up facts. Only when the real troubles are faced will true remedies be applied.

Sheffield, June 30th. E. T. GOOD.

SIXTY YEARS AGO.

IN our issue of July 7th, 1871, we waxed eloquent on the Underground Railways of London. The occasion was the opening of a new portion of the South Kensington Station and of the North Junction line between Kensington High-street and the Addision-road Station of the West London Railway, which had taken place on the preceding Saturday. That day, we rejoiced, was a day of reconciliation. The Boards of Directors of the Metropolitan and and Metropolitan District Railways "had come to an agreement for working their lines harmoniously, so that the public might be spared the misery of a broken link in the Chain of Communication." The Lord Mayor, we learn, "no longer fearful that the underground railway would invade the Mansion House, was a conspicuous guest at the official *déjeunêr*." (Why the circumflex, we wonder?) We bestowed much praise on Mr. John Fowler, the Engineer, and on the contractors, Messrs. Kelk, Waring Brothers and Lucas. "They had removed mountains of earth and executed elaborate and massive works in regions of darkness . . ." "The engineer," we exclaimed, "who rears a lofty viaduct challenges the admiration of the world; but the skill which constructs an underground railway can only appeal to the imagination of the public, quickened by statements and calculations to be taken on trust. . . . To carry a line across Chat Moss were a simpler matter, despite its stupendous scale, than to drive a tunnel through the entanglements of gas and water mains, sewers, cellars, subways and foundations, which form a species of jungle in the underground topography of the Metropolis." Every inch of the way, we went on to remark, is beset with difficulties, "something like those which encompass the surgeon in seeking to perform some delicate operation amid the maze of arteries and organs which crowd the anatomy of the human body." The idea of carrying intramural railways underground was a fortunate conception for London. That such a thing was practicable could only be demonstrated by actually doing it. Mr. Fowler had, we said, done it to an extent which gave him a foremost place among railway engineers. But there was another side to the matter! Railways, we wrote, constituted a new power in the State, and the Lord Mayor might well reflect that, with a railway running from Westminster to the vicinity of the Mansion House, there comes to an end the mediæval glories of Temple Bar. Henceforth, it will appear a farce for the Chief Magistrate of the Ancient City of London to close the gates against the newly crowned sovereign. The royal visitors have only to take the train, and forthwith they glide under the City walls and take the defences in the rear! Even Father Thames beholds a rival, and the day may come when the Lord Mayor's Show itself will be consigned to the underground railway! Our leader writer was, indeed, in a happy vein that day! Perhaps the memory of that "*dejeunêr*" still lingered with him!

A Refrigeration Plant on a Steam Lorry.

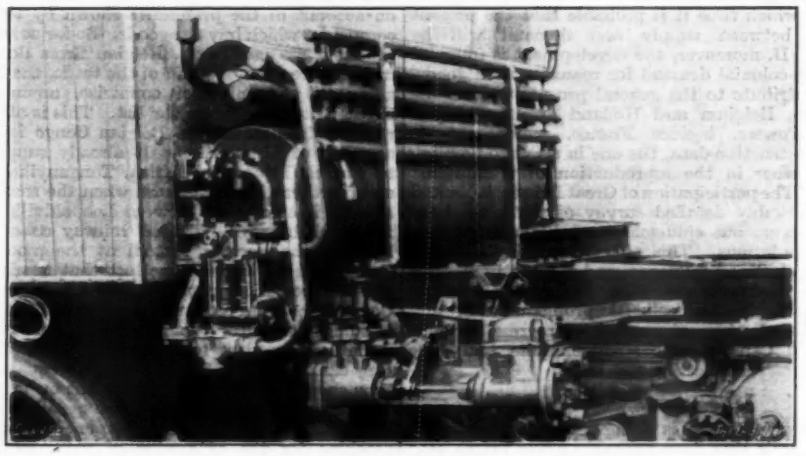
INSULATED vans and containers for the carriage of perishable foodstuffs by road have been in use for many years, and the number of such wagons is increasing. But there is a need for vans in which the temperature can be controlled during transit, which is impossible in one that is only insulated. The use of ice for keeping the temperature of the interior low is costly from the point of view of the extra weight that must be handled, and provides no certainty that the temperature will be kept low enough. While great care is taken on board ship that the conditions in which foodstuffs are stored for the voyage shall be good, similar conditions are not always available between the docks and the retailer or consumer. This condition exists in spite of the fact that there is a tendency at the present time for the demand for properly conserved food to increase.

In view of these facts, the Sentinel Waggon Works, Ltd., of Shrewsbury, has produced a van fitted with an iceless refrigerating plant. The type concerned is the "Sentinel" D.G. 6, and the silica-gel system of refrigeration, which has been in use in America for some years now, has been adopted. Silica-gel is a highly porous substance, similar in appearance to quartz sand. It is contained in an adsorber and charged with sulphur dioxide. When heated by steam, which is supplied from the boiler of the power unit, the sulphur dioxide is driven off as a vapour into a water-cooled condenser, where it is liquefied. Thence it passes into a range of gilled tubes installed along one side of the inside of the van body, and there re-evaporates, extracting heat from the air within the van. The vapour then returns to be reabsorbed by the silica-gel ready for the cycle to be repeated.

As the whole system is closed and the life of the silica-gel and the refrigerant is almost indefinite, maintenance charges are low. The only mechanically operated part is a small steam pump which supplies cooling water to the condenser, and also operates an automatic valve gear, which admits either steam or water to the adsorber as the cycle of operations requires. A clear reading thermometer is fitted in the driver's cab, which indicates when it is necessary to start or stop the pump that controls the refrigeration apparatus.

The wagon fitted with this device becomes a mobile cold store, and may be used for long-distance transport of perishable goods or their storage for indefinite periods. The cost of operating the plant varies, of course, with the refrigeration required. It is represented by the small extra amount of steam required to operate the circulating pump and to heat the adsorber. The makers claim that to maintain a temperature of 30 deg. Fah. in the body with an outside temperature of 65 deg. Fah. in the shade, the cost of the extra fuel will not exceed 1s. 6d. per day, even if the cost of the coal is as much as 40s. per ton.

The photograph we reproduce on this page shows the silica-gel apparatus fitted to the "Sentinel" chassis before the insulated body was placed in position.



SILICA-GEL REFRIGERATOR ON A "SENTINEL" WAGON

A CABLE MAKING FILM.

WITH a view to stimulating overseas trade, British Insulated Cables, Ltd., of Prescot, have prepared a cinematograph film for exhibition in North America, Australia, New Zealand, India, South America, and other countries. It is designed to show the perfection of the methods of manufacture and of research which have caused British-made cables to gain favour among engineers in all parts of the world. The film also shows many interesting scenes, depicting the erection of towers and overhead lines on the Central Scottish transmission system.

On Thursday afternoon, June 25th, the film was exhibited at the Scala Theatre, Charlotte-street, W. 1, when a large number of prominent engineers and others were present. The film opens with a set of progress diagrams illustrating the stages in manufacture of paper-insulated cable, which are followed by an aerial view of the B.I. Prescot works, which cover no less than 52 acres. Next come the old and new export departments, with their facilities for handling cables and other manufactures of the company, a view taken from the overhead crane giving a good general impression. A view of the refinery, where copper is to be seen being poured into wire bar moulds, is followed by one of the largest rod mill, with reheating furnaces, which is used for reducing the wire bar to ½in. rod in one operation. The next department shown is the pickling shop, where a load of pickled rod is being taken on a traveller to the wire-drawing shop, general and detail views of which are also shown. In the winding department, which follows, the processes of winding heavy wire on to spools for stranders and fine wire on to bobbins are shown. Two types of stranding machines are illustrated.

The film also covers impregnation lead covering, tank testing, and armouring, and the various processes involved in the manufacture of telephone cables. Views of the exterior and interior of the Helsby works, where rubber cables are made add considerable interest to the film, which deals with other of the company's products in addition to cables. The sections relating to cable laying and overhead line work are highly interesting and instructive, and serve to indicate that the company's outside contract work is highly organised.

TESTS OF A DUST ARRESTER.

IN our issue of May 8th we published descriptions of several systems of gas washing for the purpose of extracting dust and grit, and among them illustrated the Modave plant. This apparatus, which consists of a bunch of hollow, vertical baffles, placed in the stream of flue gases, over which a thin film of water is allowed to flow, has already a considerable vogue on the Continent, and has been fitted in one or two power stations in this country. One of the latest installations is at the works of Alfred Herbert, Ltd., of Coventry, and upon it a demonstration test was made on June 23rd. The Modave unit is placed between two flues, one of which is connected direct to the economiser of a works boiler, whilst the other is coupled to an induced draught fan delivering to the chimney. From each flue a small fan draws a sample of the gases and delivers it to a bag filter. The difference in the amount of material collected per unit volume by the respective filters gives the efficiency of the arrester. In order to accelerate the test, raw meal from a rotary cement mill was charged into the entrance flue to increase the dust content. All the necessary instruments for accurately measuring the volume of the gases delivered to the bags form part of the equipment. Taking efficiency $=100\ (A-B) \div A$, where A represents the grammes of dust contained in 1 cubic metre of flue gases at 0 deg. Cent. before, and B the number after, passing the arrester, then it was found that with ordinary draught and powdered fuel an efficiency of 90 per cent. was reached and under the same conditions, but with steam blowers in use in the boiler tubes, 93 per cent. was attained.

NEW STATE SALOON, S.A.R.

A NEW luxury saloon has just been completed in the Pretoria workshops of the Railway Administration for the use of the new Governor-General, His Excellency the Earl of Clarendon. This will be embodied in the White train which came into being at the time of the visit of the Prince of Wales. The addition of this new saloon will make the train more uniform in design and will give it two articulated saloons, the whole forming a striking example of the skill of the South African Railways' workshops. The saloon is of the articulated type, with two sections 45ft. in length, connected by a central vestibule over a single bogie. The entrance to the coach is made by stairlike stepboards. These steps project beyond the gauge limits, and for running purposes are folded up. The letting down of the steps automatically applies the vacuum brake. A concealed light shining directly on to the steps is switched on at night. Half of the saloon embraces a lounge, four bedrooms, a bath-room, and a hot water boiler-room, while the other portion contains a dining-room, attendants' compartments and bathrooms, as well as the kitchen and pantry. A complete system of bells and telephones permits of communication between the two sections. The dining-room, which adjoins the lounge, is 17ft. in length. The bedrooms are finished in white enamel, and are furnished with a naval type of bunk, a wardrobe, boot cupboard, and a combined writing desk and wash-basin. The temperature of the coach throughout can be regulated by steam radiators and electric fans.

An Automatically-Controlled Rectifier on the London Underground Railway.

THE first mercury arc rectifier installed in this country for heavy railway service was put into operation by the B.T.H. Company in the Hendon sub-station of the London Electric Railway Company on December 31st of last year. Among the special features of this rectifier, which is entirely of British design and manufacture, are: (*a*) Indestructible construction of anodes and anode enclosures; (*b*) six-phase excitation, giving complete stability of the arc at all loads down to zero current; (*c*) accurate temperature control, provided by a water circulating pump, and (*d*) internal heating to enable the full overload capacity to be available as soon as the rectifier is put on load. Besides the rectifier, which is rated at 1500 kW at 615 volts, the sub-station contains a B.T.H. rotary converter of the same capacity, which works in parallel with the rectifier. Both machines are automatically-controlled, and are rated to carry overloads of 50 per cent. for one hour, or three times full load momentarily. Both rectifier and converter are provided with remote control and remote metering equipment by direct pilot cables, in addition to the complete automatic control gear. To meet the special conditions of service on the London underground system, single-phase air-blast transformers were called for.

The three sub-stations, Burnt Oak, Golders Green and Hendon, can be fed alternatively from Neasden or from Lots-road, and A.C. switchgear for that purpose, as well as the main oil switches for the rectifier and rotary converter, are installed at Hendon. For the purpose of feeding the rectifier auxiliaries and control gear, an auxiliary three-phase supply at 220 volts is provided, and as it is necessary for this auxiliary supply to be available for closing the incoming feeder oil switches, each of the incoming feeders—two from Neasden and two from Golders Green—is provided with its own auxiliary transformer permanently connected to the feeder in question through current-limiting resistances and fuses. The supply to the auxiliary services at Hendon is taken from whichever one of the four auxiliary transformers happens to be first made alive, and a system of control transfer contactors on the secondary side of these transformers ensures that only one of them can be connected to the auxiliary bus-bars at a time, thus preventing any possibility of paralleling the Neasden and Lots-road supplies through the auxiliary transformers.

The general appearance of the twelve-anode rectifier is shown in Figs. 1 and 2. The mercury vapour vacuum pump and the rough pump are mounted on the rectifier itself, so that it was possible to make all the vacuum connections independent of the setting up of the plant on site. The motor which drives the rough vacuum pump also drives a small D.C. generator for supplying current to the electrical vacuum gauge and relay, and a water circulating pump, which circulates water round the cooling jacket independently of the main flow of cooling water, so as to obtain accurate temperature control. Tests are said to have shown that this patented arrangement greatly increases the overload capacity of the plant. The main supply of cooling water is controlled by a thermostatic water valve, which opens with rising temperature and thus maintains constant temperature and economy of cooling water. The actual water consumption is about 9 gallons per hour per 100 ampère hours of load, plus the small amount of water used by the mercury pump. The mercury pump is heated by transformer action, thus enabling the windings to remain cool and the risk of a burn-out that exists with resistance heated pumps is eliminated. The whole of the vacuum pumping system operates at exceptionally high speed, thus assisting in obtaining the best possible vacuum conditions.

The vacuum chamber is composed of fabricated steel plates, which were welded by the atomic hydrogen method. All the vacuum seals are of the mercury type, which enables tight joint to be made without involving heavy stresses, while, in the event of a seal developing a leak while the apparatus is in service, the sinking of a float in the stand pipe which feeds the mercury to the seal immedately gives an indication of the fault. The top half of the rectifier which carries the anodes, and which has a simple mercury-sealed joint, can easily be removed, and the entire vacuum chamber can be inspected without delay. The anodes have tips composed of a special grade of graphite and are said to resist all conditions of "bake out," overload, and "arc back," with a complete absence of deterioration. Between 50 and 100 high-power "arc backs" deliberately repeated every time on the same anode are said to have failed to produce the slightest damage. Short circuits and other methods of testing the plant have also failed to damage the anodes or their enclosures, or other parts of the apparatus.

An internal heater supplied from the main transformers enables the temperature of the rectifier to be raised before it is put on load. Careful tests, which have been confirmed by work done in America, have shown that the limiting load which a rectifier can carry without "arc back" is a function of its temperature and is very much lower when the tank temperature is, say, 15 deg. to 20 deg. Cent., than it is at 40 deg. to 50 deg. Cent. In the case of some rectifier installations, this limitation has been of no consequence, as the initial load early in the morning has not been heavy enough to exceed the limit of the cold rectifier, but under the severe conditions of service on the Underground Railways, this method of working would not be permissible. The internal heater that has been adopted enables the rectifier to be brought up to its best operating temperature before it is switched on to its load, and as the heater is of high power, the increased heating energy which would be required if the rectifier were permanently kept hot when out of service is avoided. The six small excitation anodes which serve to maintain the main arc at times of light load can be seen between the pairs of main anodes in Fig. 3. The ignition and excitation current is supplied by an air-cooled transformer, and the six-phase excitation employed enables the rectifier to carry small loads with certainty, even down to the load of a voltmeter, and it enables this to be accomplished without any sacrifice of "arc-back" protection. There are no rheostatic losses in the excitation circuit, and its power consumption is, consequently, very small. As soon as the ignition and excitation transformer set is energised, the complete process of ignition automatically takes place. To enable the upper parts of the rectifier, including the vacuum seals, to be easily inspected, and the cathode and main connections to be readily accessible in the basement, the rectifier is sunk in a hole in the sub-station floor.

The main single-phase air blast transformers for supplying the rectifier are shown in Fig. 4, which illustrates in the foreground the air blast interphase transformer which spreads the anode current over a large portion of the cycle and thus gives more efficient utilisation of the main transformer windings. The main transformers have a low-voltage tertiary winding, which is normally used for supplying the transformer blower motor and the heater in the rectifier. A set of horn gap arresters with limiting resistors protect the secondary windings from the possibility of surges being produced by the arc in the rectifier. In the event of the rectifier being opened to atmosphere for any purpose it is necessary to drive off the occluded gases from the interior before the best vacuum conditions can be obtained, and in the case of important rectifier installations it is usual to provide a "bake-out" equipment which enables the rectifier to be loaded at low voltage and progressively increasing the current in order to drive off the gases, the low-voltage supply being provided in that case by the tertiary winding on the transformer. A "bake-out" loading resistance also forms part of the equipment.

As is well known, the D.C. voltage wave produced by a rectifier contains a ripple, and, in order to ensure that this would not give rise to telephone interference, a smoothing circuit is provided to reduce the harmonics in the D.C. voltage to a value which experience with rotary converters has shown to be safe under all conditions. The smoothing circuit consists of a reactance coil in series with the D.C. side of the rectifier and five resonance shunts connected across the D.C. circuit, each consisting of a coil and condenser tuned respectively to frequencies of 200, 400, 600, 800, and 1000 cycles, and a discharge resistance and high-tension fuse protect these shunts. The D.C. reactor is of the air core type, and its coil consists of heavy

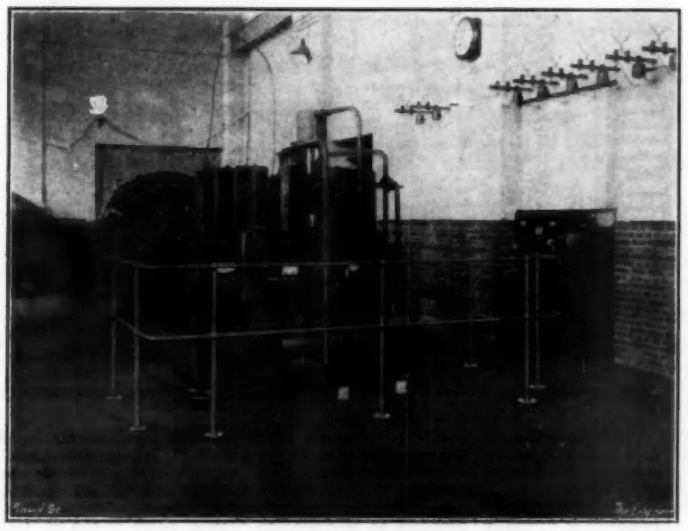


FIG. 1—VACUUM PUMP SIDE OF RECTIFIER

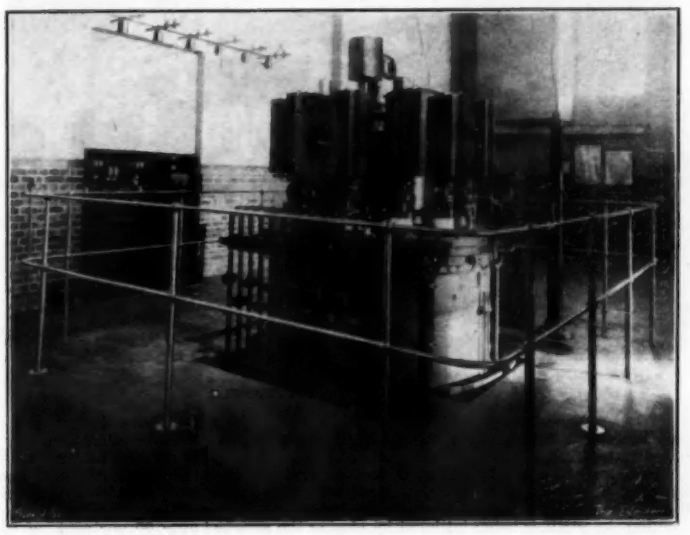


FIG. 2—VIEW OF RECTIFIER SHOWING ANODE LEADS

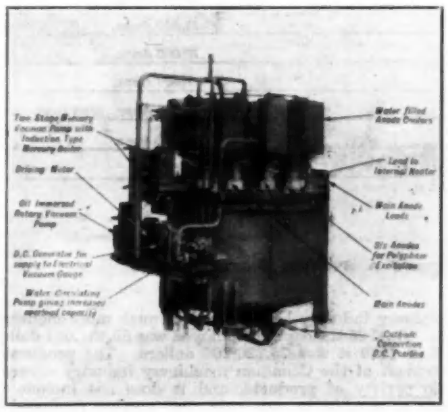


FIG. 3—VIEW OF RECTIFIER SHOWING COMPONENT PARTS

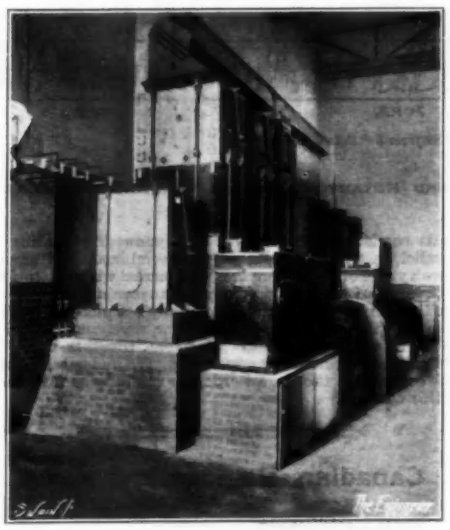


FIG. 4—MAIN AND AUXILIARY TRANSFORMERS

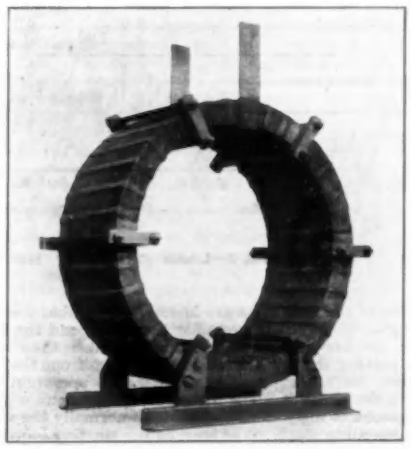


FIG 5—D.C. REACTOR

copper strip wound on edge, as shown in Fig. 5. With this equipment no trace of telephone trouble has been met with. The rotary converter and rectifier are each connected to the D.C. bus-bars through a high-speed circuit breaker on the positive side, connected for reverse tripping so that a fault in either machine, such as an "arc back" in the rectifier, will result in disconnection.

Protection against short circuits on the D.C. system is provided by high-speed breakers in the D.C. feeders arranged for forward tripping, so that the faulty feeder alone is isolated. By reason of the insulated return rail on the London Underground Railways an additional high-speed breaker is provided on each D.C. feeder on the negative side, and an electrically-operated circuit breaker is added between each machine and negative bus-bar. The D.C. feeder panels and the high-speed circuit breakers are shown in Fig. 6. In the event of an "arc back" in the rectifier, the reverse current high-speed breaker connected in series with it opens owing to the current then fed back from the D.C. line, and, as this circuit breaker is interlocked with the rectifier oil switch, the latter is also opened. A.C. overload relays with a small time delay rectifier is shut down and locked out of service until re-started by hand:—(*a*) Tripping of the A.C. earth leakage relay; (*b*) stalling of the motor driving the rotary vacuum pump; (*c*) overheating of the main transformers; (*d*) failure to complete the starting operation within a definite time; (*e*) overload on the heater circuit; and (*f*) breakdown to earth of the auxiliary circuits that are at track potential. With the exception of the vacuum gauge and relay all the devices associated with the automatic control gear are similar to those that have been used for the automatic control of other apparatus. The vacuum gauge, which is of the electrical type, gives continuous readings and depends for its action on the variations, with vacuum, of the cooling of an electrically heated filament in one arm of a Wheatstone bridge. It is designed on robust lines, operates directly on a relay with a snap action, and shuts down the rectifier if the pressure rises above the permissible limit and allows it to re-start when the vacuum has been restored. The automatic control panel for the rectifier is shown on the left of Fig. 7 and that for the rotary converter on the right.

As regards the performance of the rectifier, we are told

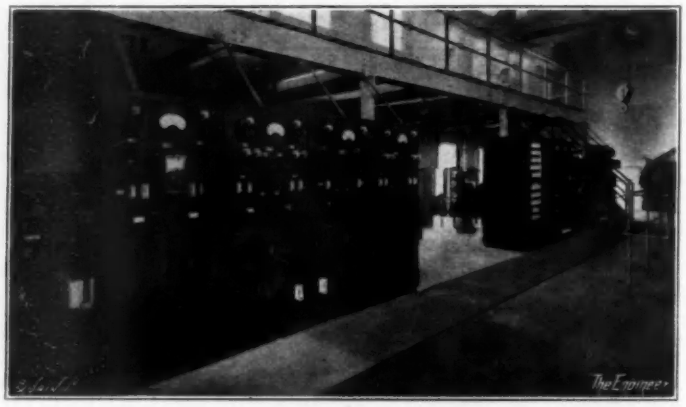


FIG. 6—D.C. FEEDER PANELS

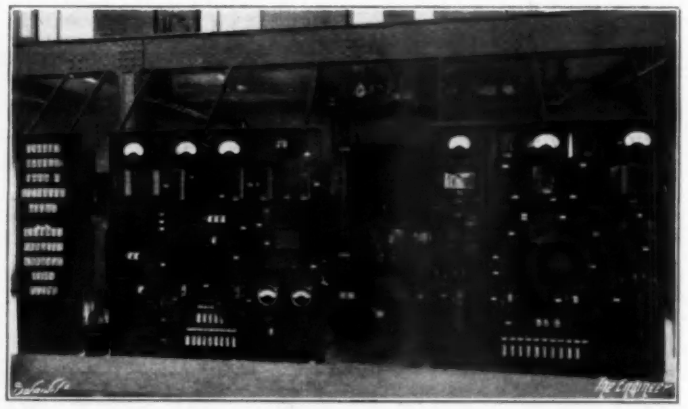


FIG. 7—CONTROL PANELS FOR RECTIFIER AND ROTARY CONVERTER

and having an inverse time characteristic are also provided on the A.C. side.

The automatic control gear for the rectifier performs the operations of starting up and shutting down and of protecting the plant against all emergencies, the operation of starting the rectifier being initiated by closing the remote control switch at Golders Green or the local switch at the Hendon sub-station. Provided that all the protective relays indicate that the rectifier is in a fit condition to operate, this operation causes the main switch to close, thereby energising the main transformer and starting the transformer blower motor. If, on the other hand, the rectifier is not at the required temperature, a thermostat prevents the starting operation proceeding further, and it switches on the internal heater. As soon as the rectifier is at the correct temperature the heater contactor opens and the excitation transformers are energised, whereupon ignition takes place automatically. If, however, the rectifier is at the proper temperature when the starting impulse is received ignition takes place immediately.

Owing to the characteristics of the B.T.H. rectifier the striking of the excitation arc immediately makes the D.C. voltage available at the rectifier terminals, and the high-speed breaker and negative circuit breaker then close, thus putting the rectifier on load. Apart from the time required for heating up the rectifier, the operation only takes a few seconds. The mercury vapour vacuum pump works continuously at all times, whilst normally the rotary vacuum pump starts up as soon as the starting impulse is received, although, if desired, a throw-over switch enables this pump also to run continuously. The stopping operation merely consists of tripping the A.C. and D.C. circuit breakers.

Signal lamps and remote control meters enable the operator at Golders Green to observe the Hendon D.C. voltage and D.C. load at any instant, and also to determine the condition of the rectifier, *i.e.*, whether out of service in process of heating or on load. In the event of any of the following disturbances, the rectifier is shut down automatically and will automatically re-start on the restoration of the correct conditions:—(*a*) Failure or excessive reduced voltage of the A.C. supply; (*b*) failure of vacuum; (*c*) failure of main cooling water, resulting in excess temperature; (*d*) excess temperature of the mercury vapour vacuum pump; and (*e*) A.C. overloads. In the event of an "arc back," immediately after a time delay of a few seconds, the rectifier automatically re-starts, and if the "arc back" is repeated the rectifier will continue to re-start itself, until after a definite and adjustable number of re-starts it is locked out of service.

In the event of any of the following disturbances the loads carried by the rectifier and converter working in parallel on that occasion, when a combined load having a peak value of 12,500 ampères was carried without trouble. By reason of the satisfactory performance of the rectifier, the London Electric Railway Company has placed a further order with the B.T.H. Company for seventeen 1500-kW rectifiers and five 2000-kW rectifiers, together with the switchgear and auxiliary apparatus. We understand that, this constitutes the largest order for rectifiers so far placed in this country.

that on the second day of service it dealt with sustained variations of load up to 4500 ampères and momentary swings up to 5500 ampères, its full-load current being 2440 ampères. During half-an-hour of the peak load period on its second day of operation its output averaged over 90 per cent. of full load. Although it is normally worked in parallel with the rotary converter, during peak load periods it has frequently been allowed to carry the peak load alone when overloads similar to those carried on the second day of service have been imposed upon it. Small light loads down to zero are invariably carried by the rectifier. The equipment was not designed to give particularly close D.C. voltage regulation. Actually the drop of D.C. voltage from light load to full load is approximately 6 per cent., and with the rotary converter working as a shunt machine the load sharing between the two types of plant is practically perfect from no load to the heaviest overloads. A disturbance on the system on January 22nd of this year, threw an extremely heavy overload on the Hendon sub-station, which was being fed by the power station at Neasden, and Fig. 8 shows the

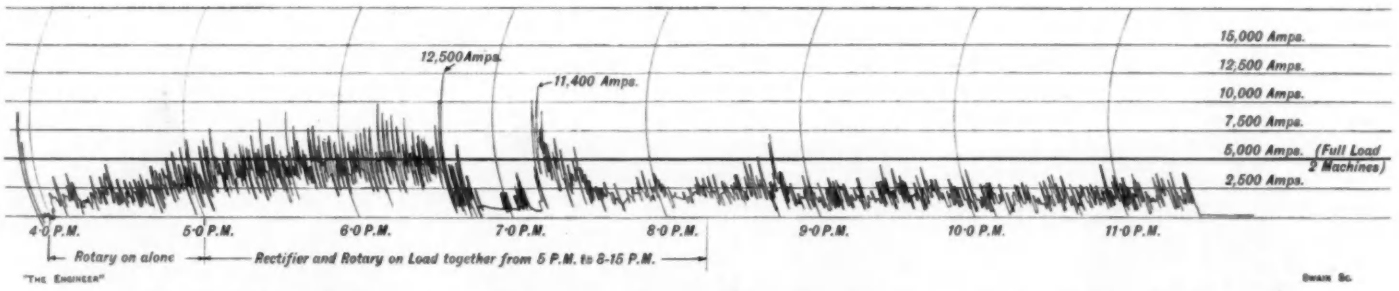


FIG. 8—LOAD CHART OF RECTIFIER AND ROTARY CONVERTER WORKING IN PARALLEL DURING A SYSTEM DISTURBANCE

Canadian Engineering News.

Rural Electrification.

THE use of electric power on the Canadian prairies is steadily expanding, adding much to the comforts of farm life in those areas. The opening of new sources of power is proceeding in all three provinces. In Alberta, the Calgary Power Company has extended a transmission line from the Bow River to Edmonton. In Saskatchewan a power plant has been opened on the Churchill River, while in the southern part of the province energy is being drawn from coal near Estevan, and lines of the Provincial Power Commission are being constructed in several directions. In Manitoba new developments are in progress on the Winnipeg River, and the Manitoba Power Commission is reaching out to parts of the province not hitherto served. Moreover, offers of power from the Nelson River have been made to the City of Winnipeg, but the carrying out of these plans has yet to be decided. In Manitoba, farmers are beginning to employ electricity freely in farm operations; while in the other Prairie Provinces the extension of power lines across rural areas is likely to bring into active operation this practice, which has for a good many years been widely followed in Ontario and Quebec.

New St. Lawrence Scheme.

Development of the international section of the St. Lawrence River between Cardinal and Cornwall, Ontario, for navigation and power purposes, together with the construction of a navigation and power canal in Beauharnois County, Quebec, is a project for which authorisation will be sought by a strong private syndicate at the forthcoming session of Parliament. While details are lacking, it is pointed out by Government engineers that the official statement of application, which proposes the construction of the canal past the international rapids section of the river, involves what might become eventually a national or international undertaking should the Governments of Canada and the United States embark upon the St. Lawrence waterway development. The syndicate proposes an all-Canadian channel north of the St. Lawrence River, and this is one of the alternative schemes put forward by the Canadian section of the International Joint Board of Engineers.

Machinery.

The industrial and commercial growth of Canada is producing a demand for increasing quantities of machinery. Generally speaking, this demand is supplied about equally by the home industry and by imports. In 1925 the output of the Canadian machinery industry was valued at 30,462,650 dollars and in 1929 at 65,692,539 dollars. Imports of machinery in 1925 were valued at 30,158,936 dollars and in 1929 at 69,574,589 dollars. In the meantime, capital invested in the machinery industry had risen at a much more moderate rate. In 1925 the capital employed was 55,431,604 dollars and in 1929 it was 75,226,204 dollars. The production statement of the Canadian machinery industry covers a wide variety of products, and it does not include all kinds of machinery, but only that portion produced in plants making machinery as their main product. It does not include, for example, a considerable amount of machinery manufactured in foundries.

New Power Project.

The Calgary Power Company, of Calgary, Alberta, which recently completed the "Ghost" hydro-electric development on the Bow River, will start surveys next spring on a power site on the Athabaska River for a dam and power-house ultimately to cost 5,000,000 dollars. It is estimated that a dam 100ft. high, if not more, could be constructed at the proposed site.

Business Conditions.

Since the beginning of the current year business generally in the Dominion has been treading a slow, if somewhat irregular, path upwards. Some industries have been able to hold the gains made at the turn of the year, and others have additional orders to execute which will keep them working on regular schedules for another three or four months. At the end of the first quarter, improvement was to be noted in the steel, automobile and agri-

cultural implement industries, in some forms of textile manufacture, and in a large number of subsidiary industries, particularly those associated with automobile manufacture. Conditions in the newsprint industry continue to reflect the results of the serious over-capacity which has been installed in recent years. These results have been gravely accentuated by the general business depression. It is notable, however, that for the first time in many years there are no new Canadian newsprint projects in sight, and no new machines in contemplation by existing companies. Therefore, any improvement in general business conditions will be substantially reflected in the newsprint industry. In the building trades and related lines there are indications of a busy season ahead, and the general outlook in this field is considered to be favourable. The revision upward of the tariff last September has attracted capital and industries to the Dominion, many of the large automobile manufacturing concerns in the United States having established branch factories on the Canadian side of the border. With the railways in the market for a considerable volume of rolling stock and equipment, and orders being placed for water power equipment and mining machinery in connection with the development work to be carried out this year, the metal-working industry generally is well employed. A recent survey shows that a number of the leading industrial and utility corporations, many of which have Dominion-wide ramifications, are planning, or actually have under projection, considerable plant extensions, in some instances running into millions of dollars in expenditure.

Asbestos Research.

The asbestos industry of Canada, which has been labouring under great difficulties for several years is turning its attention to scientific research in an effort to combat its economic problems. In 1913 the Dominion produced 86 per cent. of the world's asbestos and 71 per cent. of the money value of that product. In 1929 there was a decline to about 71 per cent. of the tonnage and 53 per cent. of the value. In 1930 there was a further serious drop. Relatively, Canada's position has been greatly weakened by the partial exhaustion of some of the richest deposits and by the rapid development of asbestos mines in South Africa and Russia, in both of which countries deposits of long and consequently valuable fibre have been opened up, and in which labour costs are only a fraction of those in Canada. Discussing this situation recently, Dr. H. M. Tory, President of the National Research Council of Canada, said: "There is reason to believe that, grade for grade, Canadian asbestos is superior for spinning purposes to the large stocks of Russian asbestos now hanging over the market. The Research Council is preparing to make authoritative tests. At a meeting of the Associate Committee on Asbestos Research set up by the Council to direct this part of its work, a programme of suggested researches looking particularly toward new uses of short-fibre asbestos and the development of suitable standards of grade and quality, were discussed. For several months the Council has had a researcher engaged on asbestos in the laboratories at Ottawa, and, already, encouraging results have been obtained."

THE INSTITUTE OF METALS.

THE Autumn Meeting of the Institute of Metals will be held at Zürich from Sunday, September 13th, to Friday, September 18th, 1931. On Sunday at 7.30 p.m. a formal opening and official welcome will be held in the "Auditorium Maximum" of the Eidgenössische Technische Hochschule (E.T.H.). The Tenth Autumn Lecture will be delivered by Mr. Ulick R. Evans on "Thin Films on Metals in relation to Corrosion Problems." At the conclusion of the lecture an informal gathering will be held in the Great Hall of the E.T.H. On Monday at 9 a.m. a general meeting will be held in the Auditorium I. (E.T.H.), when papers will be read in abstract and discussed. At 2 p.m. works visits will be made as follows by different groups:—Kraftwerke Wäggital, Wäggital, hydro-electric power station, situated about 30 miles from Zürich, for supplying power to the town and to the Swiss Federal Railways; Schaffhausen: Eisen und Stahlwerke vorm. G. Fischer (iron and steel works), Alfred J. Amsler and Co. (makers of testing machines)—at Schaffhausen the famous falls of the Rhine will be seen—or, for those who do not wish to leave Zürich, Escher, Wyss and Co., Zürich (water turbines, steam turbines, compressors, centrifugal pumps, refrigerating machinery). At 8 p.m. members and their ladies will be entertained at the Grand Hotel, Dolder, by invitation of the City and Canton of Zürich.

A general meeting of members will be held on Tuesday at 9 a.m. in the Auditorium I. (E.T.H.), and after the reading and discussion of papers the meeting will be formally closed. At 2 p.m. there will be the following visits to works:—Maschinenfabrik Oerlikon, Oerlikon, electrical machinery, power station equipment, electric locomotives, steam turbines and compressors; Brown, Boveri and Co., Baden, electrical machinery, power station equipment, electric locomotives and machinery for ship propulsion, steam turbines, condensers, compressors; Sulzer Brothers, Winterthur, internal combustion engines, refrigerating plant, heating plant, steam traps, oil electric locomotives and rail cars, small high-speed vertical steam engines, gas and air compressors. At 6 p.m. there will be a steamer trip on the lake and dinner will be served at the Hotel Wilder Mann, Männedorf.

On Wednesday, Rigi Kulm will be visited, and the party will spend the night in Lucerne.

Leaving Lucerne at 9 a.m. on Thursday, September 17th, Interlaken will be visited. In the afternoon the party will leave for Thun, where the members will visit the rolling mills of Schweizerische Metallwerke, Selve and Co. The night will be spent at Thun.

On Friday alternative tours will be available, visits being paid to the aluminium alloys rolling mills at Chippis-Siders and the watch factory of Louis Brandt et Frère at Biel. The members, after these visits, will return to England or proceed to Milan for the International Foundry Exhibition.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

No Change.

THOUGH the suggested international debt moratorium encourages hopes of brighter business in the future, it has had no marked effect upon Midland iron and steel prices, the upward movement of non-ferrous metal values not having been followed by iron and steel. Indeed, varying ideas exist as to the probable effect of events on iron and steel values. While some manufacturers believe that prices are likely to advance in the near future, other industrialists hold that only on a lower price basis can a trade revival be built. The market continues depressed, consumptive demand showing, if anything, a further falling away. Trade in all the main manufacturing industries, especially of the Black Country, continues to decline, and business is secured only by means of severely cutting prices. One or two Midland constructional engineers are moderately busy, but they are the exceptions. The automobile engineering industry is falling off as the season advances, but in the electrical industry the radio section is entering upon production for next season. Other branches of the electrical trade are also in a relatively good position. The Staffordshire and Worcestershire hollow-ware trade shares in the prevailing depression. The only section which appears to be keeping up is that relating to aluminium goods. Attendance on 'Change in Birmingham this week was moderately good, but the aggregate of business done was not large. The prices paid for iron and steel were much the same as those which ruled a week ago.

Pig Iron Prices Re-affirmed.

The Central Pig Iron Producers' Association held a meeting a week ago at which it was decided not to make any change in the fixed minimum selling rates of foundry and forge grades of raw iron produced in the district over which the Association holds sway. Midland blast-furnacemen had not held out to consumers any hope of a reduction in prices, and the market was generally prepared for the decision arrived at. The trading position in this area shows no improvement, and demand is sluggish in all departments. Cleveland ironmasters continue to complain of the "gradual growth of consumption of Midland iron" in North Country districts, but Northamptonshire smelters do not claim to be doing a large business in these markets. They have certainly secured some small scale orders, being, as they are, under no restriction as to price when competing in Northern districts. Production at Derbyshire, Northamptonshire and North Staffordshire furnaces is maintained at about the recent level and the bulk of it finds a market. The selling figure for Derbyshire forge stands at £3 1s. and for No. 3 foundry, £3 6s. These figures also apply to North Staffordshire irons. Northamptonshire forge is £2 17s. 6d. and No. 3 foundry £3 2s. 6d., all per ton delivered at stations in the Black Country and subject to rebate in the case of large buyers. Continental competition in this market is practically non-existent, but it is stated that there is still a little material to be delivered here from the Continent against contracts placed some time ago when Northamptonshire iron was dearer than it is to-day, and local foundrymen found it advantageous to buy from abroad. The blast-furnace coke market remains easy. The prices noted last week still apply.

Steel.

The finished steel market shows no change. Demand is poor and steel works are eagerly seeking specifications. Steelmasters have much difficulty in arranging rolling programmes and the mills are operating much below capacity. There is no alteration to heavy steel prices, sellers holding firmly to the level of values fixed by the Steelmasters' Association. Sellers of semi-finished steel are, at the moment, displaying caution. Foreign semis are not being pushed and quotations are advancing. Under these circumstances local steelmasters are hanging on in the hope of being able to make sales at better prices in the immediate future. Many of them express their unwillingness to accept the lowest level of prices at which business could have been done a week or ten days ago. Up to the time of writing, however, there has been no general advance in quotations. Steel scrap is so unremunerative that some merchants are said to have withdrawn from the market for the time being. There is very little business indeed being done.

Manufactured Iron.

The Staffordshire manufactured iron trade is dull, and iron is certainly not less difficult to sell than it has been during the past three months. Marked bar mills are not fully employed, but makers adhere to their quotation of £12 per ton at their works. Competition is keen in the Crown bar department, makers in other districts offering material at lower prices than those acceptable to Staffordshire producers. No improvement is discernible in demand for common bars utilised in the production of bolts and nuts and fencing, and the bulk of material being made up in Black Country works is of Belgian origin. Iron tube strip is being sold at £10 12s. 6d., delivered, but consumptive requirements are rather smaller than of late. Local mills, however, have some reserves of orders.

Galvanised Sheets.

The recent improvement in inquiries for galvanised sheets from overseas markets is maintained, and one or two fairly substantial orders have been received. Values are slightly steadier, but good shipping orders would not be lost for the sake of price concessions. Quotations, generally, this week have been in the region of £9 17s. 6d. to £10 for galvanised corrugated sheets of 24 gauge. Small orders from consumers in this country continue to be fairly regularly received.

Mr. Baldwin and the Iron Trade.

The seriousness of the position into which the iron and steel trade has fallen in this country was clearly proved by Mr. Stanley Baldwin in a recent address to a Midland audience. Since it is his own trade, and since he is particularly well acquainted with the conditions existing in the Midlands and Staffordshire, close attention was accorded to his utterances. He pointed out that, whereas, before the war, we exported far more iron and steel than we imported, this year to date imports exceeded exports. This country, he said, was not nowadays obtaining its old share of such trade as there was still to be done, and indications were that when world trade increased some of our foreign rivals would increase the advantage they now held. He referred to the iron and steel trade's inability to quote competitive prices, and deplored the lack of capital in the trade, which prevented the building of new works. The industry, he said, could barely afford to replace plant. Money was running out too freely through the channels of rates and taxes, when it was badly needed for setting the industries on their feet. It is commented upon in Midland circles this week that the world consumption of steel is likely to increase greatly in the future, and this country should be placed in a position which would enable it to secure its old proportion of business. It is pointed out that the class of steel required may differ considerably in character from that formerly turned out in Midland mills, and that it is necessary to reorganise production to meet these new demands.

Transport Vehicles.

Orders for heavy transport vehicles have not been given out at all freely of late, and the recently disclosed position of one large Black Country firm of manufacturers clearly shows the extent to which business has fallen off during the past year. Though it was known that demand for motor omnibuses such as are made by the firm in question had slumped, industrialists hereabout were not prepared for the heavy trading loss which the year's working showed. All orders for commercial passenger-carrying vehicles are keenly competed for at date, and although a goodly proportion of the available business comes into this district, works are far from fully employed. The Birmingham Corporation has just placed an order with the General Electric Company, Ltd., Witton Works, Birmingham, for eleven trolley omnibuses, the chassis for which are being supplied by Leyland Motors, Ltd.

Unemployment.

A further 15,500 have been added during the week to the list of Midland unemployed, bringing the total up to the somewhat alarming one of 402,000. This is more than 134,500 in advance of the figure of a year ago. Birmingham and the Black Country towns, with the exception of Smethwick, Oldbury and Cradley Heath, all show deterioration in trade, and there can be no doubt but that the position is becoming extremely serious. Of the unemployed in the area, 247,833 are wholly without employment, and 153,576 are temporarily workless. In the Stoke-on-Trent area there was a decrease on the week of over 1100.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

A Welcome Newcomer.

TRAFFORD PARK, Manchester, which is Lancashire's most modern and most highly centralised industrial area, has attracted still one more industry to its folds. This will be a branch factory, situated in Third-avenue, of E. F. Houghton and Co., of Philadelphia. For the present it is understood that operations will be confined to the manufacture of metal working oils, motor oils from Pennsylvania crude material, textile oils and softeners, heat treating salts, and carburising compounds, and plant for this purpose has been installed. Later on, it is proposed to embark on the manufacture of leather belting at Trafford Park. Messrs. Houghton have branch factories also in Canada, Germany, and France. The announcement of the venture follows closely upon the recent formation of the Lancashire Industrial Development Council—too closely perhaps for the two to be directly connected. It is, however, regarded as a somewhat happy augury. The Industrial Development Council, by the way, has just prepared a memorandum setting out the advantages of the county from the point of view of electricity costs for industrial power purposes.

Industrial Results.

Most of the accounts of Lancashire firms engaged in the engineering and heavy industries that have been issued during the past few days reveal a worsening of the financial position. Those of John Hetherington and Sons, Ltd., Manchester, textile machinery manufacturers and machine tool makers, for the year to the end of March last show a net loss of £73,867, compared with one of £53,344 in the previous year and a net profit of £70,578 in 1928–29. It is pointed out that during the financial year a further shrinkage of home and foreign orders took place, causing lower prices and more intensive competition. There was no demand for rayon machinery, and only a reduced demand at lower prices for machine tools. The operations of the Lancashire and Yorkshire Waggon Company, Ltd., Heywood, near Manchester, have resulted in a net profit of £4387, against £8581 in the previous year and £7866 in 1928–29, and here again the directors stress the fact that the depression has been much more severe during the twelve months ending March 31st. An interim dividend of 4 per cent. has already been paid, but no final distribution will be made, the usual total being 10 per cent. The trading profit reported by the directors of Monks, Hall and Co., Ltd., Warrington, iron and steel bar, hoop and rod manufacturers, for the past year is reduced to £8018. The results of Ward and Goldstone, Ltd., Pendleton, Manchester, electrical cable and accessory

manufacturers, make a relatively bright showing, for the net profit has been increased to £10,726 for the year to the end of March last from £5479 in the previous year, the 1928–29 profit amounting to £13,825. The ordinary shareholders are to receive a dividend of 7 per cent.

Textile Machinists' Hopes from Proposed Merger.

Reference to the proposed merger of Lancashire textile engineers was made by Sir Walter Preston, chairman of directors, at the annual meeting this week of Platt Brothers and Co., Ltd., Oldham. The six companies concerned, he said, will pool their research work, technical knowledge, and methods of manufacture, and the merger must have the effect of reducing costs and of saving in the cost of the sales organisations scattered all over the world. Sir Walter explained that if the requisite sanctions are obtained, the companies will sell their textile machinery manufacturing assets to a holding company, which will then resell, without profit, the assets which it bought from each company to a subsidiary company bearing a name similar to that of the original manufacturing company.

Non-ferrous Metals.

Heavy dealings and increased firmness have characterised all sections of the non-ferrous metals markets during the past week. Neither copper nor lead has maintained the highest price touched since my last report, but in both these metals, as with spelter and lead, values at the time of writing represent appreciable improvements on balance. Stocks of tin held in this country continue their upward trend, but in spite of this, quotations are higher by a little over £5 a ton, and a brisk business has been done in the metal. Buying interest in copper has also been much more active, although many of the transactions reported have been of a speculative character. Standard brands are dearer at the moment of writing by about £1 a ton, with advances also in the refined descriptions. Relative to price, the most formidable upward movement has been witnessed in spelter, and the aggregate turnover in this section has been heavy. The net advance has been rather more than £1 a ton. There has been a steady demand about for lead, but the rise has been much less pronounced than in the previous week, current values being about 10s. a ton higher than at last report.

Iron and Steel.

Iron and steel market conditions have been somewhat brighter, more especially in the foundry iron section, sellers reporting a better tonnage disposed of, due primarily to an improvement in the order books of one or two textile machinery concerns. There is, however, little disposition so far for users to revert to the old practice of covering requirements for any distance ahead. Values are held at 67s. per ton, delivered Manchester or equal distance, for Derbyshire, Staffordshire, and North-East Coast No. 3, 65s. 6d. for Northamptonshire, about 87s. 6d. for Scotch, and 81s. for West Coast hematite. Bar iron is unchanged at £9 15s. per ton for Lancashire Crown quality, and £8 5s. for No. 2, but the demand in this section is as quiet as ever. Constructional engineers are dealing with a better volume of inquiry, and there are hopes of a freer movement of steel in this direction before very long. There has been little perceptible improvement, however, in the rate at which plates and other varieties of steel are being taken up by locomotive builders. Makers of alloy steels have lately booked fair orders. Boiler plates are quoted at up to £9 per ton for acid and basic sorts, small re-rolled bars at about £6 10s., joists at £8 15s., sections at £8 7s. 6d., tank plates at £8 17s. 6d., and large diameter bars at £9 7s. 6d.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade continues to be very thin, with Scotland and Wales taking but little tonnage, while the Midlands' requirements are on the light side. The demand on steel account is confined to Cumberland, in so far as the output of railway material is concerned, and stocks in that district are not showing appreciable signs of coming down. At Barrow the furnaces are still damped down and stocks are being reduced slowly. There have been some shipments of iron coast-wise, and a small cargo or two has gone to Liverpool for transhipment. Continental business is quiet and American orders up to the present are on the light side. There has not been a direct shipment to Philadelphia for some time. The iron ore market is feeling the pinch, and trade, generally speaking, is slack, both as regards local and foreign sorts. The steel trade is quiet. The rail mills at Barrow are still idle, and at Workington old contracts are being worked out faster than fresh orders are coming in. The hoop mills at Barrow are fairly employed, but the American tariffs have not done this department much good. The special mill on small bars of high-grade steel for motor springs, &c., is working and is likely to continue to do so.

SHEFFIELD.

(From our own Correspondent.)

Hopes of Revival.

THE new attitude of the Powers towards the payment of war debts has inspired a feeling of cheerfulness, and there is a growing impression that a turn in the tide of the world's trade may be looked for, and that Sheffield will benefit along with other centres. There are reports of improved order books in a few cases, but the actual situation is not much affected yet, and depression is still general, with only one or two exceptions. There is not much likelihood of any early revival, as July and August have always been the quietest months in the iron, steel, and allied trades, but the autumn is viewed with optimism.

A Look Round.

The state of the open-hearth steel trade shows no improvement. Production is still on a minimum scale, with bulk orders conspicuously absent, and little promise in inquiries. The great works of the United Steel Companies, which were closed for stocktaking all last week, were not able to reopen until the middle of this week. In the same trade in Lincolnshire the situation shows some further decline. The armament departments are busier than they have been for some time, orders having been received by one or two firms for both armour plate and projectiles. The production of stainless and corrosion-resisting steels is on a large scale, though not quite up to the best former levels. A large chemical works in the North of England has been closed, and that will affect the stainless steel trade, as that material now plays a predominant part in the construction of chemical plants, and there is a regular demand for parts of apparatus made from it. The automobile industry, which has afforded a large outlet for Sheffield products during recent years, is still a good customer, but its requirements show a considerable decline when compared with those of a couple of years ago, and several firms are being seriously hit as a result. In high-grade tool steel and special steels for various purposes there is much stagnation. Exports of steel and steel material remain low, though in a few instances orders from overseas' customers show some improvement.

Railway Material.

The departments producing axles, tires, and springs for railway use are still very short of work, as both home and overseas requirements are being kept down to a low level. The hopes of early improvement, from the placing of orders in connection with the Chinese Boxer Indemnity Fund, are, however, now stronger than ever. Several million pounds are to be spent on rails, rolling stock, axles, tires, springs, and stores for the Chinese railways. Large quantities of the work have already been allocated, and arrangements completed for the inspection of the material. Sheffield firms are obtaining a good share of the work, and the actual orders are expected at any moment. Some amount of railway material is wanted by India just now, and tenders have to be in shortly. The Bengal-Nagpur Railway is inquiring for 550 steel coaching tires; the Barsi Light Railway Company, underframes and bogies for coaching stock; and the South Indian Railway Company, flexible buffers, helical and volute springs, straight and crank axles, and dog spikes. There is to be an extension of activities at the L.M.S. works at Derby, but this will be at the expense of the Crewe railway carriage works, which are being closed down and the majority of the men transferred. It is the intention of the company to centralise its carriage-building and repair activities at Derby.

A Proposed Amalgamation.

Since I wrote last week on the position of William Cooke and Co., Ltd., a new prospect has been presented by an offer from the Templeborough Rolling Mills, Ltd., of Rotherham, to purchase all the share capital. The price offered is 10s. 3d. for each preference share and 6s. 3d. for each ordinary share. All the shares are of £1 each, fully paid, and the total share capital of the company is £250,000. The Templeborough Rolling Mills, Ltd., is owned by three firms in the steel and wire trade, one of which is William Cooke and Co., which holds £72,001 of the capital. Its mill is equipped for the continuous production of wire rods on the most up-to-date lines, and is one of the finest in the world. The directors of Cookes express the opinion that the assets of their company should be worth more than the offer now made, but, having regard to the position of the company, the difficulty of realising such assets, and the immediate outlook in the iron and steel trade, they feel that they cannot do other than recommend the shareholders to accept the offer, as they themselves are doing.

Sheffield Aerodrome Scheme.

The question of the establishment of a commercial aerodrome for Sheffield has been brought forward on several occasions during recent years, but has not made much real progress. Now, however, it is to be reopened, and with perhaps better prospects. It might seem an easy thing to establish such an aerodrome, seeing that at Coal Aston, on the outskirts of the city, is a site which was used for that purpose during the war, and on which extensive buildings were erected. The matter has been complicated, however, by the fact that the joint hospital authorities of the city have had a scheme for the building of a great medical institution in close proximity, and it has been urged that the noise of flying would be harmful to the patients. But the passing of the Local Government Act of 1929 placed at the general disposal a large poor law hospital, which makes present extension unnecessary, and, moreover, the existing financial position is such that the idea of building a big hospital at Coal Aston is not likely to be carried out for many years. In these circumstances, the Chamber of Commerce has suggested that an aerodrome might be tried for an experimental period of five years, the question to be again reviewed at the end of that time. The cost of restoring Coal Aston aerodrome to its former use is not expected to exceed £1000, and the Chamber of Commerce is prepared, while this restoration is in progress, to negotiate with aircraft firms for the provision of aeroplanes and the necessary *personnel* and equipment, so that flying can commence as soon as the site has been put in order. The next move is with the City Council, and the Town Clerk has been instructed to prepare a special report on the whole subject.

Motor Spirit from Coal.

The production of motor spirit from cannel coal on a commercial scale is now in progress at the works of the Welbeck Distillation Company, near Welbeck Colliery, North Notts. The first experiments and the laying down of the plant took place five years ago, when the aim was to convert the cannel coal into crude oil, for which there was a fair demand at that time. Conditions changed, however, and the company applied its ingenuity to experiments which have had the present result. It is stated that as a commercial proposition the spirit bids fair to be a great success. The process is of value to the coal industry, as providing a new outlet for the fuel, and is also of much interest from the point of view of the home production of motor spirit.

Humber Bridge.

The Select Committee of the House of Commons which has been dealing with the Humber Bridge proposal has decided, after thirty-two sittings, that the preamble is proved, and has reported the Bill for third reading. Before this decision was come to several interesting undertakings were given by the promoters. They accepted responsibility, without regard to time, for the construction of works if the main channel of the river was altered by the building of the bridge. In regard to height, they amended the Bill so as to provide that the height should be 80ft. above high water level, with the exception of two end spans. The height of the main span is to be 105ft., and the width of the anchor spans is increased from 375ft. to 475ft. With regard to training walls, the Humber Conservancy Board indicated that the future construction of these walls would be beyond its resources, and the promoters have agreed that, if as the result of the building of the bridge any further work has to be carried out to rectify the course of the channel, they will bear the cost. The Humber Conservancy Board and the Goole Chamber of Commerce have both decided to carry their opposition to the Bill to the House of Lords.

NORTH OF ENGLAND.

(From our own Correspondent.)

Cleveland Iron Trade.

A CHEERLESS tone still pervades the Cleveland iron market, and no expansion in business is now anticipated until the autumn. Much disappointment was occasioned this week by the announcement that the fixed minimum prices of Cleveland pig iron will remain unchanged. Consumers had been hoping that prices would be reduced for the second half of the year, and many have been holding off the market in consequence. It would appear from the attitude adopted by the ironmasters that they are reconciled both to the loss of external markets and the invasion of the local area by Midlands and foreign iron. Whether they will be able under these circumstances to keep in continual operation the whole of the blast-furnaces now working remains to be seen. But unless business speedily improves, the outlook is not hopeful. No. 1 Cleveland foundry iron is 61s., No. 3 G.M.B. 58s. 6d., No. 4 foundry 57s. 6d., and No. 4 forge 57s.

East Coast Hematite.

The East Coast hematite pig iron trade is quiet, but a few good contracts are running and the greater stability of prices has brought in a few more inquiries. Values have sunk to a low level as compared with rates ruling for Cleveland iron. Ordinary qualities are 62s. 6d., and No. 1 grade is 63s.

Ironmaking Materials.

There is virtually no demand for foreign ore. Consumers have large stocks, and good deliveries to take under running contracts. Business is likely to remain quiet until the iron trade position shows some improvement. The nominal price of best Rubio ore remains at 15s. c.i.f. Tees. Demand for blast-furnace coke does not improve. Consumers state that they experience no difficulty in satisfying their requirements on the basis of good average qualities at 15s. 3d. delivered at North-East Coast works, but producers are not disposed to discuss forward business except on higher terms.

Manufactured Iron and Steel.

Conditions in the manufactured iron and steel trade are little changed. Inquiries for one or two commodities are a shade better, but orders for nearly all descriptions of material are much needed to keep works in their present state of partial activity. Sheet makers are faced with keen competition by Belgian firms for orders for galvanised kinds, and America is invading markets that have hitherto drawn supplies of black sheets from this district. Fixed steel prices are due for revision this month, and it is hoped that some concessions will be made.

Shipbuilding.

Work is to start almost at once on a small cargo steamer at the Neptune Works, Walker-on-Tyne, of Swan, Hunter and Wigham Richardson, Ltd. The vessel will be specially designed to carry fruit and general cargoes. It is expected that the building of the vessel will provide five to six months' work. Further orders are expected by Tyne firms in the next few weeks. Work at the shipbreaking yard of Hughes, Bolckow, Ltd., Blyth, is certain up to the end of the year, the firm having secured H.M.S. "Cleopatra," a light cruiser of 3750 tons. The vessel, which now lies at Sheerness, has been put out of commission under the terms of the disarmament agreement. She is due at Blyth at the end of this month.

Colliery Closes Down.

Burnhope Colliery, one of the oldest pits in North-West Durham, was closed down last week-end, and 800 men and youths were thrown out of work. The reasons for the pit closing down are depression in the coal trade, heavy costs of production, and transport charges.

The Coal Trade.

The general demand for most descriptions of coal is very slow, but with the clearing up of old contracts and the beginning of deliveries under July-December commitments, the market is a shade brighter. June was a difficult month for the collieries, many of which in Durham were compelled to lose days for want of orders,

while others in Northumberland had more business than they could cope with and had either to lie idle or buy quota from their neighbours at a premium over the current prices. The prevailing feeling is that July is likely to be a dull month. Deliberations over miners' hours and wages and uncertainty as to what will happen on July 8th, when the 7½-hour day comes to an end, are not, apparently, arousing much interest abroad, for the simple reason that in Europe there is no need for dependence on British supplies. At one time there was cause for anxiety if English pits stopped, but Poland changed all that during the British national stoppage of 1926. As already indicated, there is nothing very encouraging about the July prospects, and it may be that the autumn will be reached before business shows any real expansion. A few inquiries are in hand from Scandinavia, and certain tenders have been sent in this week. Durham may secure a good share of the orders where gas coals are concerned, but even in this specialised fuel there is much more competition than there used to be. Of course, in steam coals Poland usually offers much below the prices asked from this district, and the quality of Silesian fuel stands high. Trade for large Northumberland steams is slow, and smalls are as great a drug as ever. There are thousands of tons accumulated on the ground. Best steams are quoted at 13s. 6d., and second qualities at 12s. The demand for gas coal is below the ordinary summer level, and the hot weather in the South is checking the home demands from that quarter. Best descriptions are offered freely at 14s. 6d., and secondaries at 13s. 6d. The Wear prime qualities are quietly steady at 15s., while Durham coking unscreened and secondary bunker qualties are in ample supply at 13s. to 13s. 3d., with best bunkers moving off steadily at 13s. 6d. to 13s. 9d. After a long period of stagnation the demand for patent oven coke is looking up, there being numerous orders and inquiries circulating for early shipment. Tonnage stems are being earmarked, and the undertone of the market is steadier. Prices, however, are unaffected owing to the stocks available. Good class brands are about 14s. 6d. Superior foundry coke is steady and unchanged in value at 17s. to 20s. Gas coke is steady for best qualities at 19s.

New Method of Pipe Making.

The South Durham Steel and Iron Company, Ltd., has, at its pipe works, Stockton-on-Tees, begun the commercial production of steel pipes by the automatic metallic arc process, the first of its kind in England. An order for 5 miles of 15in. pipe is at present being manufactured for the Sunderland Gas Company. This main will have its joints welded *in situ*, thus, in fact, making a continuous main. At intervals all joints made *in situ* are thoroughly tested by means of compressed air. It is claimed that as far as strength is concerned, this new form of construction is equal to, or better than, the gas welded pipe. Plates of a much higher tensile strength than could be welded by the water gas process can be successfully welded by the electric process, this enabling manufacturers to offer pipe with lesser wall thickness for equal duty. The machines can accommodate pipes from 15in. to 100in. diameter by 30ft. long.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

SINCE the beginning of this year the output from the Clyde month by month has been almost the lowest on record. The returns for June, amounting to two vessels of 10,600 tons aggregate, is also the lowest, with the exception of June, 1923, when labour disputes restricted the production. This year to date the total output from the Clyde only amounts to thirty-six vessels of 103,871 tons, compared with 114 vessels of 293,166 tons in the same period last year. The oil tanker "Eclipse," 9800 tons, was the only vessel of note to be launched during the month of June. So far as new business is concerned, the contract placed for four destroyers on behalf of the Portuguese Government is the most important order secured for the Clyde this year. The only other orders reported in June were one for a 350-ton tug for the Karachi Port Trust and a buoy-layer for the Bombay Port Trust.

Steel.

In this district the half-dozen steel works in operation are all on short time. Home demands are very restricted, and export is very quiet. The weakness of continental prices has a most unsettling influence. The scarcity of shipbuilding orders is still pronounced. Business in tubes is not improving. The works are operating on alternate weeks only in most cases, but one or two have closed for longer periods. Makers of butt-welded tubes have been able to buy continental tube strip at the low figure of £4 7s. 6d. per ton. Sheet makers do not find much improvement so far, but inquiries have been better. Continental sheet bars have been on offer at £3 3s. 6d. per ton, f.o.b. Antwerp, while re-rolling billets, 4in. square, are obtainable at £3 1s. per ton. Steel bar re-rollers experience keen competition for any business on offer. Prices have been cut to £6 5s. home and £6 2s. 6d. per ton export. Rollers of steel tube hoops find specifications very scarce.

Iron.

Bar iron makers are having a very dull time. Home orders are few and far between, and export is almost negligible. Home prices are fixed, but export might be done under the quotation of £9 15s. per ton. Pig iron is very quiet, the demand for ordinary and hematite being restricted, owing to importations of continental and Indian iron, and the depression in the consuming industries. Only six furnaces are in operation, but supplies are plentiful; 1000 tons of pig iron arrived from Calcutta last week. Shipments of pig iron from the Clyde last week amounted to 667 tons (647 tons foreign), compared with 786 tons (757 tons foreign) in the same week last year. Prices are unchanged, but slight concessions might be gained.

Scrap.

The market for scrap is dull, and though prices are weak at 49s. 3d. for cast iron machinery and 37s. 6d. for heavy steel, easier terms are expected.

Coal

With the production now more in conformity with the demand, it is expected that a steadier tone will characterise the Scottish coal market. Outputs have been curtailed by the closing of pits and short-time working. The production of coal in Scotland has been fixed at 61 per cent. of the standard amount for the third quarter by the Central Board, but it is understood that the collieries have protested against such a small quota. Meanwhile home demands are at a low ebb, owing to the season of the year and the industrial depression, and export is still largely under the influence of foreign competition. All large fuels, with the exception of Fifeshire steams, are plentiful for prompt shipment. Washed nuts—especially the larger sizes—are, however, scarce in all districts. Aggregate shipments amounted to 246,293 tons, against 211,802 tons in the preceding week and 245,878 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

The Coal Trade.

THE steam coal trade continues to be exceedingly quiet in all its branches, and the immediate future is regarded with no little amount of anxiety, in view of the fact that, while our exports remain just about stationary, those of Poland and Germany are increasing and the competition for business is keener than ever. According to the returns of the Great Western Railway Company, shipments from the ports in this district under its control last week amounted to 438,000 tons, which compared with 444,100 tons for the preceding week and with 560,595 tons for the same week of last year. The weekly exports for the past three months have averaged 440,930 tons, so that last week's total was just a shade below it. Despite their utmost efforts, there can be no question that South Wales exporters are experiencing the greatest difficulty in finding business to maintain the recent average, and, furthermore, they are faced with proposals on the Continent that imports of coals should be regulated, which means, in all probability, that they will be decreased, so that the consumption of native coals may be increased and employment found for their own workmen. Owing to there being so much less activity in exports and a very material reduction in the chartering of tonnage, the number of idle tipping appliances at the various docks in this district at the end of last week was as high as forty-four, while the position on Monday last, as the result of week-end arrivals of steamers, was that there were still twenty idle tips, from which it will be gathered that owing to the restricted outlet for coals many collieries are compelled to work very irregularly. Current business is extremely limited, and unfortunately there is not very much inquiry for supplies of coal on contract. The Southampton Corporation waterworks are reported to be in the market for the supply of coal, cobbles and coke for delivery over six or twelve months, but the contract which has occasioned most interest is that for the supply of 100,000 tons or 200,000 tons (metric) of locomotive coals for the Egyptian State Railways, to be delivered at Alexandria over a period of four months. Firms were asked to quote on a f.o.b. basis or c.i.f. Alexandria, and tenders were opened at Cairo on Tuesday last. The news to hand is that the lowest prices have been submitted by T. Beynon and Co., Ltd., viz., 100,000 tons at 24s. 1d. c.i.f. or 17s. 8d. f.o.b. per ton. The next quotations were 24s. 11d. c.i.f. or 17s. 9d. f.o.b., from Gueret, Llewellyn and Merret, Ltd., while other firms have offered supplies at 25s. 5d. and 25s. 9d. per ton c.i.f., but when the full list of offers comes to hand it will probably be found that prices range up to a higher figure. An American firm, the Consolidated Coal Company, is reported to have offered 50,000 tons of American coal at 15s. 6d. per ton f.o.b., but it is fully expected that the order will come to this district in view of the very low prices which have been offered. The tender of Messrs. Beynon and Co. is 1s. 4d. per ton less than the figure at which the last contract was entered into for Welsh coals, and which is now being executed. The cut which has been made in order to get the business will be realised when it is pointed out that the lowest price on an f.o.b. basis scheduled under the regulation scheme for coals acceptable to the Egyptian State Railways is 17s. 9d. per ton, which leaves 6s. 4d. to cover all charges, including freight. The last rate paid for a steamer for Alexandria was 6s. 9d., and it was generally thought that that figure was low enough on which to base calculations for future business, seeing that such a rate cannot be remunerative, though the report has been current that one large firm of shipowners has been prepared to give a freight cover for this new business as low as 6s. 6d. per ton.

Miners and Hours and Wages.

It is not to be wondered at that some anxiety exists regarding work in the coalfield as from July 8th, in view of the little progress that is being made by the Government, the coalowners and the miners. Hopes of a settlement improved when the coalowners amended their offer and were prepared to stabilise the present wages for a period of twelve months if the existing hours of work were continued. Unfortunately, the offer has not led to any arrangement, and so far as this district is concerned, the executive of the South Wales Miners' Federation on Saturday passed a resolution declaring that the proposal of the coalowners was definitely unacceptable and that any proposal to continue the 7½-hour day must be accompanied by a guarantee of improved wages to be embodied in a new Minimum Wage Act. This step was followed by a conference of coalfield delegates at Cardiff on Monday, but there were divided views regarding the executive's resolution, and, ultimately, the conference was adjourned to Wednesday of this week, as the lodges had not had an opportunity of considering the report and policy of the executive. The conference, however, recommended the lodges to support the resolution of the executive council.

LATER.

When the annual conference of the South Wales Miners' Federation resumed at Cardiff on Wednesday, the delegates by a majority of about 100 passed a resolution which empowers the delegates to the National Conference to agree to the retention of the 7½-hour day conditionally upon its being accompanied by some increase in wages and embodied in a Minimum Wage Act. A concession has therefore been made by the conference, inasmuch as there is not the insistence on a seven-hour day as from July 8th. The conference now stands adjourned to Monday next, provided the discussions in London permit of this step being taken.

Coal for the Navy.

The influential deputation from South Wales to the Admiralty on the question of substituting coal for oil for naval vessels was due to meet on Wednesday afternoon of this week. The deputation is one of the largest that has ever gone from this district, and certainly very representative of all interests, and keen interest is displayed as to what may emerge from the interview. It is scarcely likely, however, that anything in the way of a definite promise to make any change will be forthcoming at the interview, though, doubtless, the members of the deputation will get a very sympathetic reception, and an undertaking that their arguments, &c., will be given every consideration.

Tin-plate Items, &c.

SIX mills at the Duffryn tin-plate works at Morriston, belonging to Messrs. Richard Thomas and Co., restarted work on Monday, which means employment for 600 to 800 men. Excepting about a fortnight's work just before Christmas, the fourteen mills at these works have been idle since last September. Owing to a dispute, operations were suspended on Monday at a portion of the mill department at the Old Castle Tin-plate Works, Llanelly. The dispute was confined to three of the new American mills, which it was intended should have resumed on Monday. The men's representatives are to meet the management with a view to settling the matter. Another two of the ten furnaces at the Swansea Vale Spelter Works, Llansamlet, were to be restarted this week, thus bringing into commission six in all. Fears were felt a few weeks ago that the whole works would have to be closed down owing to the low price of spelter, which touched a record low level at £9 12s. 6d. per ton, but since then the price has risen to over £13.

Current Business.

The tone of the steam coal market is generally very quiet, and lifeless. Numerous collieries are working short time owing to the shortage of prompt orders, while the accumulation of smalls continues so that supplies have to be banked in order to avoid wagons being occupied. Empty wagons are greatly needed to enable pits to maintain anything like continuity of work. Sized coals have lost some of their steadiness, and in all sections prices are at the minimum. Coke and patent fuel show no revival, while pitwood is weak at about 21s. 6d. to 22s.

LAUNCHES AND TRIAL TRIPS.

PAN SCANDIA, oil tank motor ship; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Astrea Company, of Oslo; dimensions, 490ft. by 67ft.; to carry oil in bulk. Oil engines, Wallsend-Sulzer type; constructed by Wallsend Slipway and Engineering Company, Ltd.; trial trip, June 16th.

TJISADANE, motor vessel; built by Netherland Shipbuilding Company, Ltd., to the order of Java-China-Japan Lijn, Ltd.; dimensions, 458ft. 4in. by 62ft. by 38ft. 6in.; to carry passengers and cargo. Oil engines, Werkspoor type; a speed of 14 knots was attained on trial trip, June 18th and 19th.

PAN EUROPE, single-screw motor ship; built by Swan, Hunter and Wigham Richardson, Ltd.; to the order of A/S "Abaco," of Oslo; dimensions, 483ft. by 65½ft. by 37ft. 3in.; to carry oil in bulk. Oil engines, Wallsend-Sulzer type; constructed by Wallsend Slipway and Engineering Company, Ltd.; launch, June 30th.

CATALOGUES.

JAMES GORDON AND CO., Ltd., Windsor House, Kingsway, W.C. 2.—A pamphlet on the Gordon thermostatic high and low-water alarm and distance indicator.

BRITISH JEFFREY-DIAMOND, Ltd., Stennard Works, Wakefield.—Bulletin 474 D, describing in some detail several examples of Jeffrey portable loading equipments.

CARDOX (GREAT BRITAIN), Ltd., 20, Copthall-avenue, E.C. 2.—"The Cardox Method of Mining Coal," substituting the action of carbon dioxide gas for explosives.

ASHWORTH AND PARKER, Riverside Works, Bury, Lancs.—A well-illustrated, 50-page book on Parker steam engines, their construction, sizes and a list of some users.

LONDON ALUMINIUM COMPANY, Ltd., Westwood Works, Witton, Birmingham.—"What we can do," a booklet showing the firm's range of products in aluminium and light alloys.

DARWINS, Ltd., Fitzwilliam Works, Sheffield.—A catalogue dealing in some detail with the manufacture of cobalt steel magnets and the various types of magnets supplied by the firm.

WAILES DOVE BITUMASTIC, Ltd., Collingwood-buildings, Newcastle-on-Tyne.—A catalogue printed in six languages upon the various applications of "Bitumastic" solutions, enamels, &c.

CHAPMAN AND HALL, Ltd., 11, Henrietta-street, W.C. 2.—A catalogue giving some 964 titles of books published by John Wiley and Sons Inc., New York, for whom Messrs. Chapman and Hall, Ltd., act as agents.

ELLIOTT BROTHERS (LONDON), Ltd., Century Works, Lewisham, S.E. 13.—"Siemens Flue Gas Analysis Equipment"; "Siemens Automatic Boiler Control"; "Siemens Heat Economy and Control in Power Stations."

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
(1) Native	16/- to 20/6
(1) Spanish	16 -
N.E. COAST—	
Native	18/- to 21/-
Foreign (c.i.f.)	15/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 10 0	—
No. 1 Foundry	3 13 6	—
No. 3 Foundry	3 11 0	—
N.E. COAST—		
Hematite Mixed Nos.	3 2 0	3 2 0
No. 1	3 2 6	3 2 6
Cleveland—		
No. 1	3 1 0	3 1 0
Siliceous Iron	3 1 0	3 1 0
No. 3 G.M.B.	2 18 6	2 18 6
No. 4 Foundry	2 17 6	2 17 6
No. 4 Forge	2 17 0	2 17 0
Mottled	2 16 6	2 16 6
White	2 16 6	2 16 6
MIDLANDS—		
(c) Staffs.—	(*Delivered to Station.*)	
All-mine (Cold Blast)	—	—
North Staffs. Forge	3 1 0	—
„ „ Foundry	3 6 0	—
(c) Northampton—		
Foundry No. 3	3 2 6	—
Forge	2 17 6	—
(c) Derbyshire—		
No. 3 Foundry	3 6 0	—
Forge	3 1 0	—
(3) Lincolnshire—		
No. 3 Foundry	—	—
No. 4 Forge	—	—
Basic	—	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	3 19 6 (*a*) / 4 1 6 (*b*) / 4 6 6 (*c*)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. COAST—		
Iron Rivets	11 5 0	—
Common Bars	10 10 0	—
Best Bars	11 0 0	—
Double Best Bars	11 10 0	—
Treble Best Bars	12 0 0	—
LANCS.—		
Crown Bars	9 15 0	—
Second Quality Bars	8 5 0	—
Hoops	12 0 0	—
S. YORKS.—		
Crown Bars	10 0 0	—
Best Bars	10 15 0	—
Hoops	12 0 0	—
MIDLANDS—		
Crown Bars	9 5 0 to 10 7 6	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 10 0 to 9 0 0	—
Gas Tube Strip	10 12 6	—

STEEL. (*d*)

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates (Marine)	10 10 0	10 10 0
„ „ (Land)	10 10 0	10 0 0
Ship Plates, ½in. and up	8 15 0	7 15 0
Sections	8 7 6	7 7 6
Steel Sheets, ¼in.	7 10 0 to 7 15 0	8 0 0
Sheets (Gal. Cor. 24 B.G.)	11 7 6 10 6 0 to 10 5 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	8 15 0	7 15 0
Angles	8 7 6	7 7 6
Boiler Plates (Marine)	10 10 0	—
„ „ (Land)	10 0 0	—
Joists	8 15 0	7 7 6
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5s.
Hard Billets	8 2 6	—
Soft Billets	6 17 6	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 5 0	—
Light Rails	8 10 0 to 8 15 0	—
Billets	6 10 0 to 9 0 0	—
MANCHESTER—		
Bars (Round)	9 7 6	—
„ (Small Round)	6 10 0	—
Hoops (Baling)	10 0 0	9 15 0
„ (Soft Steel)	9 0 0	8 15 0
Plates	8 17 6 to 9 2 6	—
„ (Lancs. Boiler)	9 0 0	—
SHEFFIELD—		
Siemens Acid Billets	9 2 6 (basis)	—
Hard Basic	8 2 6 and 8 12 6	—
Intermediate Basic	6 12 6 and 7 2 6	—
Soft Basic	6 0 0	—
Hoops	9 10 0 to 9 15 0	—
Soft Wire Rods	7 15 0	—
MIDLANDS—		
Small Rolled Bars	6 7 6 to 7 0 0	—
Billets and Sheet Bars	5 0 0 to 5 15 0	—
Galv. Sheets, f.o.b. L'pool	9 17 6 to 10 5 0	—
(2) Staffordshire Hoops	9 10 0	—
(*d*) Angles	8 7 6	—
(*d*) Joists	8 15 0	—
(*d*) Tees	9 7 6	—
(*d*) Bridge and Tank Plates	8 17 6	—
Boiler Plates	9 0 0	—

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14 f.o.b.	13/6 to 13/9
Block Tin (cash)	114 2 6
„ (three months)	116 0 0
Copper (cash)	38 10 0
„ (three months)	39 0 0
Spanish Lead (cash)	13 18 9
„ „ (three months)	13 11 3
Spelter (cash)	13 8 9
„ (three months)	13 15 0
MANCHESTER—	
Copper, Best Selected Ingots	40 0 0
„ Electrolytic	41 10 0
„ Strong Sheets	70 0 0
„ Tubes (Basis Price), lb.	0 0 10½
Brass Tubes (Basis Price), lb.	0 0 9½
„ Condenser, lb.	0 0 11½
Lead, English	14 12 6
„ Foreign	13 10 0
Spelter	13 5 0
Aluminium (per ton—raw ingot)	£85

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/11½ per lb.	
Ferro Tungsten	1/8½ per lb	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 0 0	7/-
„ „ 6 p.c. to 8 p.c	£20 12 6	7/-
„ „ 8 p.c. to 10 p.c.	£19 17 6	7/-
„ „ Specially Refined		
„ „ Max. 2 p.c. carbon	£30 0 0	10/-
„ „ „ 1 p.c. carbon	£34 0 0	12/-
„ „ „ 0·70 p.c. carbon	£36 0 0	14/-
„ „ „ carbon free	9½d. per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£11 0 0 for home	
„ „ „	£11 10 0 for export	
„ Silicon, 45 p.c. to 50 p.c.	£10 10 0 scale 5/- per unit	
„ „ 75 p.c.	£15 0 0 scale 7/- per unit	
„ Vanadium	12/9 per lb.	
„ Molybdenum	4/2 per lb.	
„ Titanium (carbon free)	9d. per lb.	
Nickel (per ton)	£170	
Ferro Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	13/6
„ „ Ell	14/-
„ „ Splint	14/6 to 16/-
„ „ Trebles	12/-
„ „ Doubles	11/6
„ „ Singles	10/6
AYRSHIRE—	
(f.o.b. Ports)—Steam	12/-
„ „ Jewel	17/-
„ „ Trebles	12/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	10/6 to 12/-
Screened Navigation	16/6 to 17/6
Trebles	11/6 to 13/-
Doubles	11/- to 11/6
Singles	10/6
LOTHIANS—	
(f.o.b. Leith)—Best Steam	10/9 to 11/-
Secondary Steam	10/3 to 10/6
Trebles	12/-
Doubles	11/3 to 11/6
Singles	10/6

ENGLAND.

	Inland.	Export.
(8) N.W. COAST—		
Steams		20/-
Household		30/- to 51/-
Coke		20/- to 20/6
NORTHUMBERLAND—		
Best Steams		13/6
Second Steams		12/-
Steam Smalls		7/6 to 8/-
Unscreened		12/6 to 13/-
Household		27/- to 39/-
DURHAM—		
Best Gas		14/6
Second		13/3 to 13/6
Household		25/- to 37/-
Foundry Coke		24/-
SHEFFIELD—		
Best Hand-picked Branch	24/6 to 25/6	—
Derbyshire Best Bright House	19/- to 20/-	—
Best House Coal	18/6 to 20/-	—
Screened House Coal	17/- to 18/-	—
„ „ Nuts	14/6 to 15/-	—
Yorkshire Hards	15/- to 16/6	—
Derbyshire Hards	15/- to 16/6	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	6/- to 7/6	—
Smalls	4/- to 5/6	—
Blast-furnace Coke (Inland)	12/3 on rail at ovens	
Furnace and Foundry Coke (Export), f.o.b.		14/- to 15/-

(9) SOUTH WALES.

CARDIFF—	
Steam Coals :	
Best Smokeless Large	20/- to 20/3
Second Smokeless Large	18/9 to 19/9
Best Dry Large	18/6 to 19/3
Ordinary Dry Large	17/9 to 18/-
Best Black Vein Large	18/3 to 18/9
Western Valley Large	18/- to 18/6
Best Eastern Valley Large	17/9 to 18/-
Ordinary Eastern Valley Large	17/9 to 18/-
Best Steam Smalls	13/6 to 14/-
Ordinary Smalls	11/- to 13/-
Washed Nuts	18/- to 21/-
No. 3 Rhondda Large	19/9 to 20/3
„ „ Smalls	15/- to 16/-
No. 2 „ Large	17/- to 17/3
„ „ Through	15/6 to 16/-
„ „ Smalls	14/- to 14/3
Foundry Coke (Export)	22/- to 36/6
Furnace Coke (Export)	16/6 to 17/6
Patent Fuel	20/- to 20/6
Pitwood (ex ship)	21/6 to 22/-
SWANSEA—	
Anthracite Coals :	
Best Big Vein Large	35/- to 37/6
Seconds	27/- to 31/6
Red Vein	22/6 to 27/6
Machine-made Cobbles	41/6 to 45/-
Nuts	43/- to 46/-
Beans	24/9 to 28/3
Peas	21/- to 21/9
Breaker Duff	8/6 to 9/6
Rubbly Culm	8/6 to 9/6
Steam Coals :	
Large	20/- to 20/6
Seconds	18/- to 20/-
Smalls	11/6 to 13/-
Cargo Through	16/- to 17/6

(1) Delivered. (2) Net Makers' Works. (3) f.o.b. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire. (6) Home Prices—All delivered Glasgow Station. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (*a*) Delivered Glasgow. (*b*) Delivered Sheffield. (*c*) Delivered Birmingham. (*d*) Rebate : Joists (minimum), 22/6 ; Ordinary Ship, Bridge, and Tank Plates and Sections, 15/- if home consumers confine purchases from associated British Steel Makers. (*e*) Delivered Black Country Stations.

French Engineering Notes.

(From our own Correspondent in Paris.)

Railway Reforms.

THE conclusions of the Conseil Supérieur des Chemins de Fer regarding the reforms to be carried out in order to save the railway companies from financial disaster have, for the most part, been accepted by the Government, which is introducing into the Chamber of Deputies a Bill in favour of some of the reforms suggested. The report of the Conseil Supérieur was very similar to that of the Under-Director of the Bank of France. In both cases it was affirmed that the companies, if relieved from parliamentary interference and allowed to administer the railways on their own initiative in the same way as other industrial undertakings, would be able to place the railways on a sound basis. The Government now proposes to fix the passenger rates on the gold standard; that is to say, the pre-war rates will be multiplied by a coefficient of 5, which represents the depreciation of the franc. This step will augment the existing rates by something like 30 per cent. There will be no increase in goods freights, and they may even, in some cases, be reduced, and there is not likely to be an appreciable change in the rates for suburban traffic. The State will reduce the fiscal taxes on passenger tickets from 32·5 per cent. to 12 per cent. The railways will postpone the carrying out of a number of works. On local lines steam locomotives will be superseded, where necessary, by rail motors and even by road vehicles. A measure of far-reaching importance, which is bound to arouse considerable opposition, is the proposal to relieve the railway companies from the disabilities arising from the competition of road transport, which is not burdened with charges and which pays nothing for the use of the roads. The Bill provides for a tax on the turnover of all goods traffic on roads and for an increased tax on petrol. This higher petrol tax appears to have a double object, for while enabling the Treasury to recover its loss of revenue from the reduction of the tax on railway passenger tickets, it will facilitate the efforts of the State to impose the use of alcohol in admixture with motor fuels. All these steps represent an upheaval that is bound to make the passage of the Bill, though inevitable, extremely difficult.

Solid Fuels.

The series of congresses on fuels extending over the period of six months during which the International Colonial Exhibition will remain open is divided up into sections dealing with different categories of fuels. Last week the congress on solid fuels was of a more summary character than the others, partly because some of the fuels will be dealt with separately at future meetings. It was admitted that very little progress has been made with these fuels during the past year. Concentration could hardly be expected in dealing with so many different kinds of fuels, but new ideas and developments appear to indicate that more useful work will be done in the early future. Solid fuels for motor traction naturally involve the employment of gas producers. These producers have been improved in the way of reducing the column of fuel, which is now, in some cases, not more than 6in. in height and the generator is consequently much smaller and lighter. Another new development is air injecton at high velocity into the combustion space, whereby the by-products of fuel like coal containing not more than 12 per cent. of volatile matter undergo a rapid distillation. Last year Monsieur Roux, the general commissioner at the congress, travelled some thousands of miles in Belgium with a motor car equipped with a gas producer in which all the different kinds of coal found in that country were used. The efforts to use French peat failed through its containing too much ash, and the lignite in France has too high a sulphur content, though, of course, these substances are employed in the manufacture of composite fuels. From the colonial point of view, wood is the most convenient fuel, and it will be dealt with more fully at a future meeting on gas producers. The distribution of wood in Africa is, however, very irregular, for while there are jungles in some colonies where there can be little traffic, in others, like Senegal, there is comparatively little wood. It has been shown, however, that trees suitable for carbonisation can be planted and will grow very rapidly, so that it is always possible to produce an ample supply of wood that will make a homogeneous fuel. Briquettes can be made with sawdust by the companies exploiting forests, but in a general way it is held to be uneconomical to expend the costly energy necessary on a poor waste product. Hopes are centred more particularly upon torrefied wood, about which more will be heard shortly. As transport is a big factor in fuel costs, it is concluded that the different fuels must receive equal attention so that each colony will be able to utilise that which is the cheapest obtainable.

Compagnie Generale Transatlantique.

The Government has rejected the offer of a group of shipowners to take over the Compagnie Générale Transatlantique, and it is now confronted with the alternative of financing the company with the aid of a group of bankers, shipowners and shipbuilders, and exercising a more effective control over the business, or of buying up the company's controlling stock and running it with a board of directors which the Government will itself select. In the latter case it means that the C.G.T. would be run by the State. It is hardly conceivable, after the disastrous experience of the State ownership of a merchant fleet during the years following the war, that the Government will embark upon another undertaking of this kind. There are two developments, however, which indicate that the Government is not averse to the State working of enterprises of national interest, one being the construction of three fast ships for the cross-Mediterranean service and the other the organisation of a company controlled by the State for the development of civil aviation in Africa.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

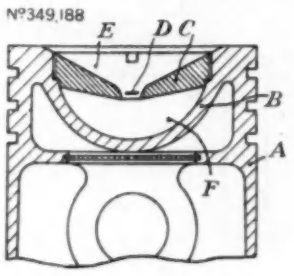
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

349,188. March 15th, 1930.—PISTONS, Aero Aktiengesellschaft, Küsnacht am Rigi, Switzerland.

This invention relates to oil engine pistons of the type having an auxiliary compression chamber in the form of a bowl which is in communication with the cylinder chamber by a funnel-shaped opening. Three alternative designs are illustrated in the specification. In that which we reproduce the head B of the cast iron piston is recessed in the shape of a bowl and

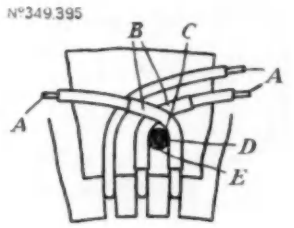


machined on its upper side. In the region of the upper rim of the piston recess is cut a thread into which is screwed a correspondingly threaded cover C. This is made from carbon steel and has a narrow orifice D at its centre, this being the only connection between the funnel-shaped space E on the outer side of the cover and the chamber F of the piston below the cover. The upper side of the cover subtends the greatest part of the hopper-like space.—*May 28th*, 1931.

DYNAMOS AND MOTORS.

349,395. September 8th, 1930.—HIGH-POTENTIAL DYNAMOS, Siemens-Schuckertwerke Aktiengesellschaft, of Berlin-Siemensstadt, Germany.

The object of this invention is to prevent a glow discharge between the coil ends and the holding bolts of high-potential electrical machines. The insulated conductors A are surrounded

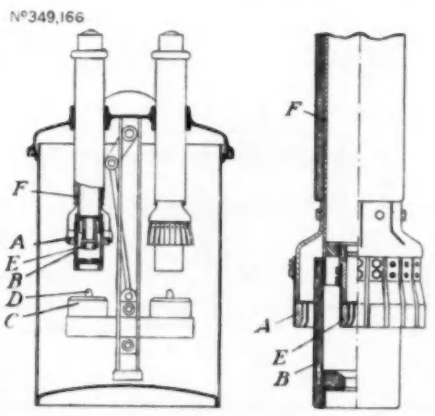


by a semi-conductive coating B, and the insulating sleeve C which surrounds the holding bolt D is coated with a semi-conductive material E. The conductors and the insulating sleeve of the bolt are in contact with each other so that the semi-conducting layers on both parts come together, thus greatly increasing the protection against glow discharge.—*May 28th*, 1931.

SWITCHGEAR.

349,166. March 7th, 1930.—OIL SWITCHES OF HIGH INTERRUPTING CAPACITY, "Elin" Aktiengesellschaft für Elektrische Industrie, of Volksgartenstrasse 1–5, Wien 1, Austria.

This invention relates to an oil switch of high rupturing capacity for use with high operating currents. In the con-

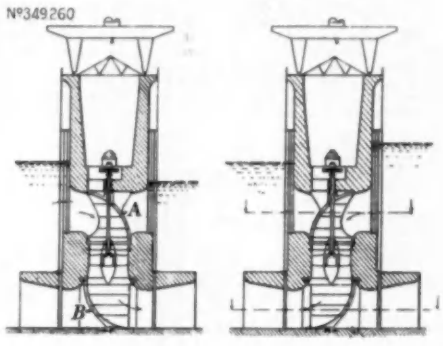


struction of oil switches for extremely high working currents certain difficulties arise when these switches are intended to have a high interrupting capacity. These difficulties arise in particular when the switches are, as is usual with high-capacity oil switches, of the extinguishing chamber type. The principle hitherto followed of arranging the main contacts within the extinguishing chamber leads to progressively increasing difficulties as the ampérage increases. Apart from the large amount of space required for the accommodation of the large main or switch contacts of this kind intended for currents of high ampérage within the extinguishing chamber, this arrangement has the disadvantage that the main contacts housed in the extinguishing chamber can become charred by the heat of the interrupting arc even if separate arc rupturing contacts are likewise provided within the extinguishing chamber. The avoidance of any burning away of the main contacts is, however, an absolute necessity in switches for high currents. These difficulties are overcome in accordance with the invention by the disposition of the main contacts intended for the conducting of the steady current outside the extinguishing chamber. The contact contained within the extinguishing chamber plays the part merely of an arc or spark rupturing device, which is connected in parallel with the main contact and closes sooner, and opens later than the main contact, so that the formation of an interrupting arc occurs only at the arc rupturing contact, that is to say, within the extinguishing chamber. In accordance with the invention the main finger contacts A of a high-capacity switch encircle the extinguishing chamber B. A tubular counter contact C, which embraces the extinguishing chamber B, is forced in between these concentrically disposed main contacts for the purpose of closing the circuit. The contact proper D of the spark rupturing device E disposed within the extinguishing chamber is placed on the axis of this concentric arrangement of contacts, and is electrically and mechanically connected with the tubular counter-contact C. The advantage is thus gained that the extinguishing chamber B is not only a pressure or explosion chamber, but also forms an insulating partition between the spark rupturing device E and the main contacts A, so that the latter remain protected from the arc at break. In connection with this concentric arrangement of contacts an additional feature has been introduced, namely, the employment of tubes F of large bore as leading-in conductors.—*May 28th*, 1931.

TURBINE MACHINERY.

349,260. April 29th, 1930.—TIDAL POWER PLANTS, The English Electric Company, Ltd., 28, Kingsway, London, W.C. 2, and P. W. Seewer, 11, Wildwood-road, Hampstead Garden Suburb, London, N.W. 11.

This invention is concerned with water turbines of tidal power stations, in which it is necessary to reverse the direction of flow

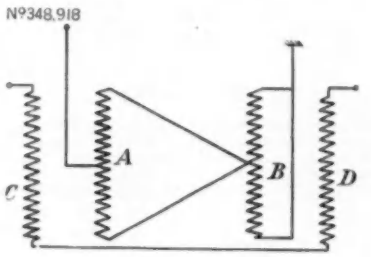


with each tide. The turbine is shown at A and is connected with water on each side of the dam by duplicate inlet and outlet passages. At the intersection of each of these pairs of passages there is a bend A and B, which can be rotated about a vertical axis to effect the reversal of flow, as shown in the drawings. The mechanism for operating them is not mentioned.—*May 28th*, 1931.

TRANSFORMERS AND CONVERTERS.

348,918. June 13th, 1930.—SINGLE-PHASE TRANSFORMERS, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

This invention relates to a single-phase transformer with windings distributed over two limbs, one pole of one winding being permanently earthed. According to the invention, in the case of the earthed winding, the winding parts on each limb are divided into at least two parallel branches, and the branches so connected together that the lowest potential always prevails at the ends of the winding parts which face the yokes and the ends of the winding part on one limb to which the voltage is supplied in the middle are connected to the middle of the wind-



ing part on the other limb. A, B, and C D are the windings distributed over the limbs of a transformer core, of which, for instance, A B is the high-tension winding. The voltage is supplied to the winding part A in the middle, its ends being connected to the middle of the winding part B, the ends of which are both earthed. In this way the winding parts A B are resolved into two parallel branches, so that at the ends of the winding parts there will always be the lowest potential and the potential will increase uniformly to the middles of the windings. Owing to the highest potential being on one of the transformer limbs, the insulation of the winding of the other limb can be made very slight, so that the size of the transformer is substantially reduced.—*May 21st*, 1931.

TRANSMISSION OF POWER.

349,240. April 15th, 1930.—INSULATORS FOR ELECTRIC CONDUCTORS, Electrical Improvements, Ltd., of Carliol House, Newcastle-upon-Tyne, and Peter Johnston Ryle, of By-way, Lilburn Gardens, South Gosforth, Northumberland.

Apparently this specification relates to the anti-dirt insulator referred to in Mr. Ryle's paper read before the Institution of

Electrical Engineers last February, and mentioned in a leading article appearing in our issue of February 27th. The insulator A is generally of bell shape with its inner surface B smooth. The outer surface of the insulator is provided with a number of circumferential ridges C, so that the greater part of the possible leakage path is on the exposed upper surface. The diameter of each ridge is appreciably less than that of the ridge below it,

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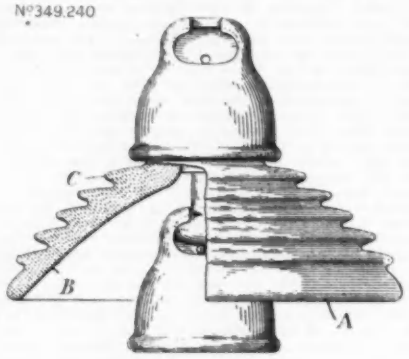

so that the ridges do not overhang each other to any great extent, and the undersides of the ridges slope downwardly and are not upwardly re-entrant. This arrangement ensures that the whole of the upper surface of the insulator, including the undersides of the ridges, is fully exposed to the wind and rain and is consequently kept free from accumulations of dirt which would tend to make the insulation relatively inefficient.—*May 28th*, 1931.

MEASURING AND TESTING INSTRUMENTS.

349,631. December 3rd, 1929.—Apparatus for Indicating the Rate of Flow of Fluids, The Paterson Engineering Company, Ltd., of Windsor House, Kingsway, W.C. 2, and William Smalley, of the same address.

In the application of this invention to the measurement of liquid flow in a filtration plant the liquid is made to pass through a venturi pipe connected to the outlet from the filter, and so arranged that the differential pressure set up by the flow through the tube will create a minor flow through a shunt circuit or by-pass A B, one end of which is connected to the throat of the venturi. The indicator may take the form of a slightly conical or tapered tube C, in which a plunger D is free to rise with the

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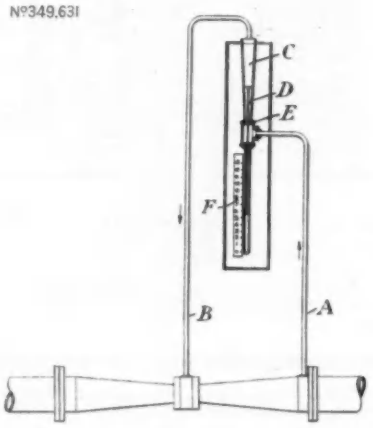

flow of water so that as it rises it will afford an annular orifice between the tube and the plunger, the latter being free to rise in the current of liquid while taking up a position which is dependent upon the velocity of flow and the weight of the plunger. When there is no upward flow through the tapered tube the plunger will sink to its lowest position where it completely seals the inlet opening E, and when the flow is established it will rise to such a position in the tapered tube as will give an annular orifice of sufficient area to create a difference of pressure which is balanced by the resistance offered by the plunger. A calibrated scale F may be associated with the indicator to give a direct reading of velocities according to the position of the plunger.—*June 4th*, 1931.

FURNACES.

349,138. February 28th, 1930.—Electric Resistance Furnaces, Willoughby Statham Smith, of Benchams, Newton Poppleford, Devonshire, and Cuthbert Victor Henry Garnett, of "Woodhall," Woodland Rise, Sevenoaks, Kent.

According to this invention, an electric resistance furnace is

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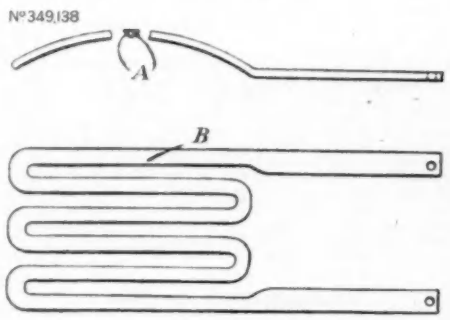

provided with a heating grid or grids constructed from bar or casting of a substantially triangular cross section so arranged that two sides A of the triangle are facing the area to be heated. The grid as a whole is curved inwardly so as to concentrate the heating rays in the centre of the heating area, the base B of each fold of bar facing outwardly and the remaining two sides facing towards the heating area. The chief advantages of the construction are :—(1) Increased mechanical strength, especially at high temperatures ; (2) for any given unit, the ratio of spacing to conductor is greater, with consequent less liability for shorting ; (3) greater useful heating surface combined with less liability for local impurity to cause hot spots owing to the greater effective thickness of the conductor ; (4) greater ease of manufacture and therefore lower cost, as it is easier to cast a triangular section than to make a thin strip.—*May 28th*, 1931.

349,266. May 2nd, 1930.—Suspended Furnace Roofs, H. Römer, 19 Engerstrasse, Düsseldorf, Germany, and G. Karrenberg, 51 Makkabäerstrasse, Köln, Germany.

In this construction of furnace roof the fire-bricks are hung from hollow bars A through which a circulation of air is main-

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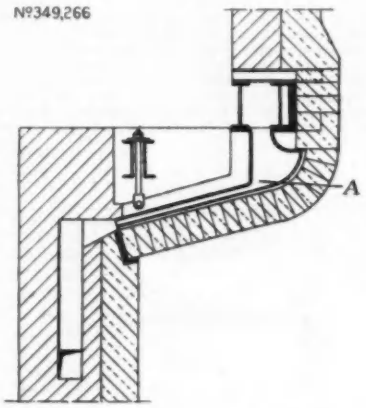

tained in order to keep them cool. Several alternative arrangements for supplying the bars with air are suggested, as also means of supporting the bars ; but there is no hint as to whether or not the warmed air should be turned to any useful purpose.—*May 28th*, 1931.

MISCELLANEOUS.

349,411. October 14th, 1930.—Mercury Vapour Rectifiers, Aktiengesellschaft Brown, Boveri et Cie., of Baden, Switzerland.

An arrangement is described in this specification for fixing the cathode spot of a mercury vapour rectifier. A is the cathode vessel with the collecting vessel for the cooling water attached to it, and B are the anodes. The bottom plate of the cathode vessel A is provided with parallel grooves, in which the sheet metal pieces

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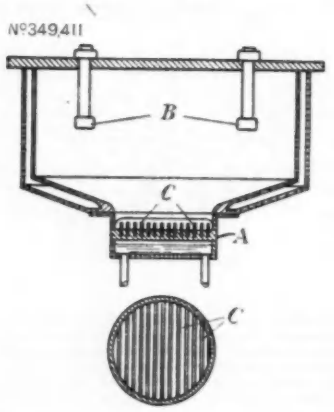

or strips C are fixed by caulking, for obtaining a good heat contact. The sheet metal strips are placed on edge and terminate below the level of the mercury, the mercury being about 1 mm. to 5 mm. above the edges of the strips. The distance between the sheet metal strips is at least 5 mm. The insertion may also consist of a separate base plate laid on the bottom plate of the cathode and composed of a non-amalgamating, non-atomising metal, to which the sheet metal strips, which are placed on edge, are welded.—*May 28th*, 1931.

349,421. March 19th, 1930.—Pipe Joints, The Bromford Tube Company, Ltd., and E. N. Stant, Wheelwright-road, Erdington, Birmingham.

In this pipe joint reliance is placed on the ring A to make a steam-tight joint against high pressures. The ring is of com-

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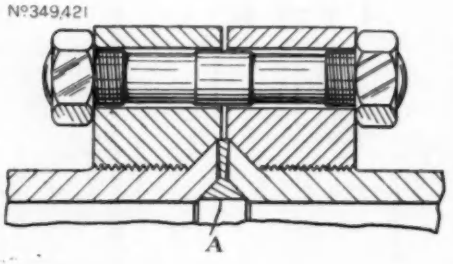

paratively hard metal, such as steel, and is wedge-shaped, as shown. The inner bore of the ring is slightly larger than that of the pipe. The ends of the pipes are bell-mouthed and provided with heavy flanges. When the bolts are tightened up the ring A is compressed by the wedging action so that its bore coincides with that of the pipe.—*May 28th*, 1931.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY AND SATURDAY, JULY 4TH.

Institution of Naval Architects.—Paris summer meeting. For programme see page 514, Vol. 151

Second International Congress of the History of Science and Technology.—For programme see page 524, Vol. 151.

MONDAY, JULY 6TH.

Royal Institution of Great Britain.—21, Albemarle-street, W. 1. General meeting of members. 5 p.m.

TUESDAY TO SATURDAY, JULY 7TH TO 11TH.

Royal Agricultural Society of England.—Warwick Show.

WEDNESDAY TO FRIDAY, JULY 8TH TO 10TH.

Institution of Mining Engineers.—Ninety-third general meeting at Manchester. For programme see page 690, Vol. 151.

THURSDAY, JULY 9TH.

British Electro-Farming Conference.—In the Members' Large Tent, Royal Agricultural Show, Warwick. Sixth Conference. "Electricity on the Farm, including Dairy and Poultry Farming," by Mr. M. M. Harvey. 3 p.m.

MONDAY TO FRIDAY, JULY 13TH TO 17TH.

Institution of Mechanical Engineers.—Summer meeting at Cambridge. For programme see page 10.

MONDAY TO SATURDAY, JULY 13TH TO 18TH.

Society of Chemical Industry.—Jubilee Celebrations. For provisional programme see page 471, Vol. 151.

SUNDAY TO SATURDAY, SEPTEMBER 6TH TO 12TH.

International Association for Testing Materials.—Congress at Zürich.

THURSDAY TO SATURDAY, SEPTEMBER 10TH TO 26TH.

Shipping, Engineering and Machinery Exhibition.—Olympia, W. Daily, 11 a.m. to 9 p.m.

SATURDAY TO WEDNESDAY, SEPTEMBER 12TH TO 16TH.

International Foundry Congress.—Milan.

SATURDAY TO SUNDAY, SEPTEMBER 12TH TO 27TH.

International Foundry Exhibition.—At Milan.

SUNDAY TO FRIDAY, SEPTEMBER 13TH TO 18TH.

Institute of Metals.—Autumn meeting at Zürich.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Buck and Hickman, Ltd., have removed their offices from 62, Market-street, Manchester, to larger premises at 277, Deansgate, Manchester. Mr. John P. Schofield will continue to act as manager of the Manchester office.

George Cohen, Sons and Co., Ltd., 600, Commercial-road, London, E. 14, inform us that they have decided to extend to the sale of modern machine tools and equipment that system of time payments which has proved so successful for other industries, and are offering British works the facility of paying for their purchases by equal instalments spread over two years.

CONTRACTS.

The British Thomson-Houston Company, Ltd., has received an order from H.M. Office of Works for "Mazda" gas-filled and vacuum lamps for the period ending May 31st, 1932.

Yarrow and Co., Ltd., of Scotstoun, Glasgow, have received an order for two Yarrow patent water-tube land boilers, with superheaters, economisers and mechanical stokers, which are being supplied through Guest, Sykes, Ltd., of Johannesburg, to the Government of Northern Rhodesia for the new electricity undertaking at N'Dola.

Simon-Carves, Ltd., of Cheadle Heath, Stockport, have received an order from the Wath Main Colliery Company, Ltd., Wath-on-Dearne, near Rotherham, to extend its "Baum" washery from 75 tons per hour to 150 tons per hour. The original washery, with a capacity of 50 tons per hour, was erected in 1908 by Simon-Carves, Ltd., and extended by them in 1924.

Ruston and Hornsby, Ltd., of Lincoln, have received instructions to supply to A.R.P. Studios, Ltd., of London, three airless-injection vertical oil engines totalling 1425 brake horse-power. All three engines will have six cylinders and will use cheap fuel oils. Two will be of 600 B.H.P. and the third 225 B.H.P., and they will generate electricity required for all the power and light needed in the new Ealing "Talkie" Studios.

The Parsons Oil Engine Company, of Southampton, has received an order for two of its Y6S paraffin engines of the six-cylinder type, 117 H.P., coupled to 80-kW generators, as emergency plants for the Imperial and International Communications Offices. It has also received an order from Messrs. Denny, of Dumbarton, for two 30-kW paraffin emergency generating sets for a new cross-channel vessel, the engines concerned being of the 50/90 H.P. M4S type.

Fuel Questions.—The Fuel Committee of the Society of Chemical Industry has arranged that the papers which will appear in the *Journal* of the Society on July 3rd next shall be discussed at a meeting which will be held on Thursday, July 16th, in the Marylebone Room, Great Central Hotel, London, at 10.30 a.m., at which the chair will be taken by Sir Arthur Duckham, G.B.E., K.C.B. The Society of Chemical Industry has invited all members of the Institute of Fuel to be present at this meeting, when Dr. C. H. Lander will open the discussion. Any who are interested in fuel questions are cordially invited to attend. Tickets of admission may be obtained from Mr. H. J. Pooley, general secretary, Society of Chemical Industry, Central House, Finsbury-square, London, E.C. 2.